MECHANICAL ENGINEERING

· MARCH 1950 ·

Developments in River Transportation of Petroleum . . . . . *C. R. Horton, Jr.* 205

Mechanized Job-Shop Foundry for Aluminum . *C. H. DeLamater* 211

Absorption Refrigeration . . . . . *A. A. Berestneff* 216

Quality-Control Indicator . . . . . *R. C. Miles* 221

New Concepts of Abrasive Properties as Affecting Grinding Performance . . . . . *H. H. Wagner* 225

Aviation as an Instrument of Peace . . . . . *H. L. Dryden* 227

The Obligation of Management to Provide Leadership . . . . . *F. S. Blackall, jr.* 229

Registration by Endorsement . . . . . *D. B. Steinman* 232

Departments

Briefing the Record, 235
ASME Technical Digest, 247
The Engineering Profession—News and Notes, 263
ASME News, 267
Keep Informed (Advertisers), 39

How Much Profit Do You BURN At Your BOILER?

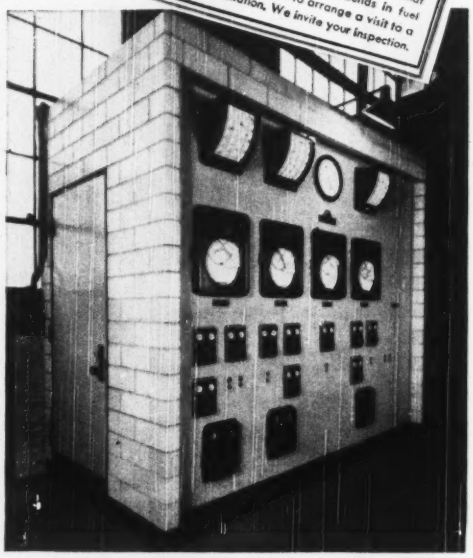
You Are Invited

There is a quick easy way to convince yourself that co-ordinated boiler control pays dividends in fuel saved. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We invite your inspection.

$ Fuel dollars wasted at the boiler cut your profits. If you are seeking ways to trim costs you may find your boiler room is the place to begin. Make certain you are getting co-ordinated boiler control. This way you can be sure you are getting maximum returns from your fuel dollars.

The Bailey co-ordinated boiler control system prevents wasted fuel. It increases safety of operation, improves continuity of service and reduces maintenance costs. Combustion, feed water, steam temperature, heater levels, pump speed, and all other factors are co-ordinated to deliver maximum power at minimum cost.

The Bailey co-ordinated boiler control system pays its way in fuel saved because every system is engineered to the specific conditions under which it must operate. Like your power plant, it fits the job. To find out how Bailey controls can improve your boiler performance, we suggest that you—



This installation of Bailey Boiler Control on three boilers fired by underfeed stokers insures fuel economy, safety of operation, and continuity of service.

Call This Man

He is a Bailey engineer. Back of him are years of experience in engineering control systems for fuel burning equipment of all types. He will work directly with you and your engineers in the design and application of the meters and controls required by your installation.

This engineering service is yours for the asking—available in more than 30 industrial areas throughout the United States and Canada.

BAILEY METER COMPANY

1026 IVANHOE ROAD
CLEVELAND 10, OHIO

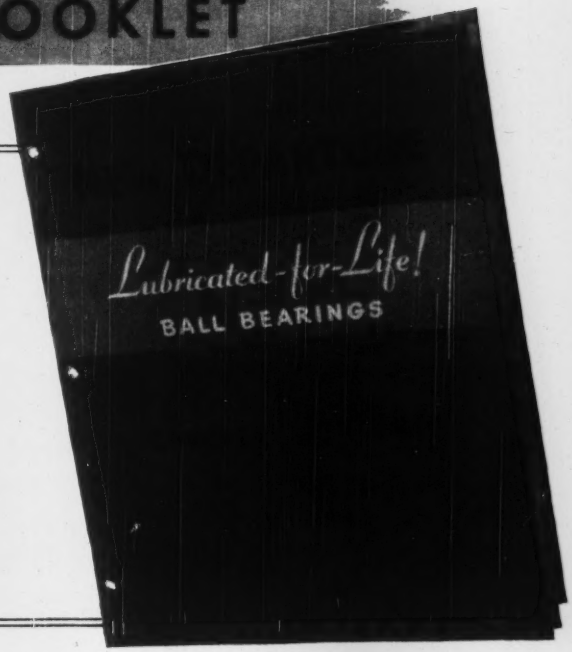
Controls FOR STEAM PLANTS

COMBUSTION • FEEDWATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

For anyone interested in

Conveyor Systems

... FREE BOOKLET



Authoritative
•
Documented
•
Illustrated
•
Dimensions and Capacity Tables

MORE THAN any other single invention perhaps, the mechanized conveyor system lifts the load off man's back and puts it on the machine.

It is a typically American invention, and it represents a typically American way of getting things done.

By originating and developing ball bearings which are lubricated-for-life and are sealed to keep dirt out, New Departure made a contribution of major importance to the modern conveyor system.

Proved in installations operating under rugged conditions, in temperatures from below zero to desert heat, and exposed to dust and dirt . . . carriers developed around these lubricated-for-life conveyor bearings are giving years of service without any cost for greasing.

The story of New Departure Conveyor Bearings and the services that go with them is told in a new booklet, illustrated above.

If you design or manufacture or use conveyor systems, you will find it interesting and helpful reading. Mailed promptly, to requests on business letterheads.

Nothing Rolls Like a Ball . . .
NEW DEPARTURE
BALL BEARINGS

90

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, March, 1950, Vol. 72, No. 3. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price 75¢ a copy, $7.00 a year; to members and affiliates, 50¢ a copy, $4.00 a year. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations.

Wallace Barnes Springs

Bristol Connecticut

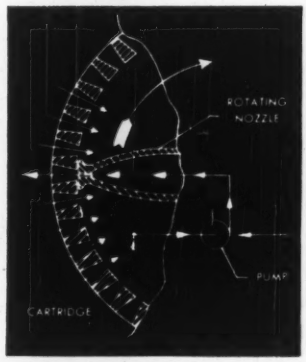
Save Water Automatically

and save money, too!

If water's scarce in your community, here's a painless way to cut down consumption.

If water isn't scarce yet, it's still expensive (particularly if you have to heat it or treat it), and here's an easy way to cut down its cost.

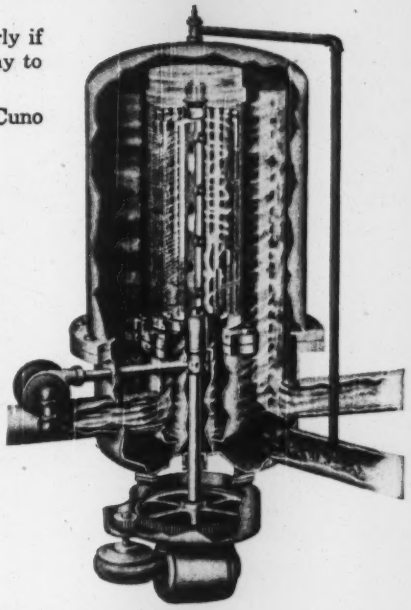
Make dirty water *fit for use* and *re-use* with a Cuno FLO-KLEAN Strainer.



Permanent, Resists Abrasion and Corrosion

Cuno Flo-Klean Filter makes raw water suitable for many plant services . . . keeps recirculated water clean . . . *pays for itself in as short a time as a year.* Permanent wire-wound cartridge positively removes all solids larger than spacing specified.* Pressure drop is exceptionally low because fluid moves in a straight line, encountering only momentary restriction.

**Available spacing from .0025 in. to .020 in.*



Continuously self-cleaning without fluid waste

There is no loss of backwash fluid. Used backwash is returned to the system. With no interruption of flow for cleaning the strainer, no duplex installation is needed. Operation, including sludge removal, may be completely automatic.

No Fluid Is Better Than Its Filtration

CUNO

Complete Line Fluid Conditioning

Removes More Sizes of Solids from More Types of Fluids

MICRONIC (MICRO-KLEAN) DISC-TYPE (AUTO-KLEAN) WIRE-WOUND (FLO-KLEAN)

Find Out How to Save Money

cleaning any fluids containing abrasives

CUNO ENGINEERING CORPORATION
659 South Vine St., Meriden, Conn.

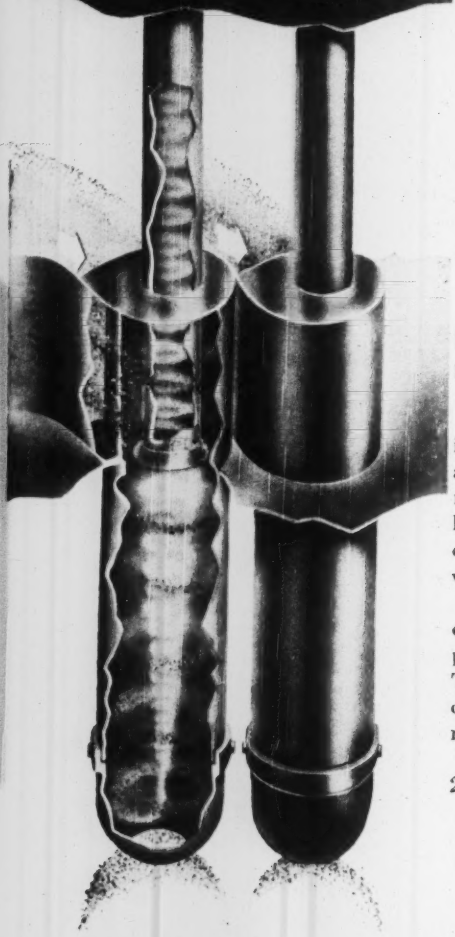
Please send information—without obligation—on Cuno FLO-KLEAN for application noted:

.....
.....
.....

Name.....Title.....
Company.....
Address.....
City.....State.....

PLEASE ATTACH COUPON TO YOUR BUSINESS LETTERHEAD

THE INLET THAT Boosted COLLECTION Efficiency



Exclusive in the
VALMONT TYPE S DUST COLLECTOR

High collection efficiency in the ultra-fine dust range below 20 microns was the goal attained by Prat-Daniel Corporation with the introduction of the Valmont Cyclonic Tube —the tube with a high, narrow inlet.

The advantage of this patented inlet proportion design is that it reduces the radial distance of travel of dust particles as they spiral downward. Ultra-fine particles, entering the high, narrow inlet of the Valmont Type S Tube near the center, have less distance to travel to the tube wall and a greater percentage of them will reach that wall before the downward spiral is ended, without excessive tangential velocities normally required.

As dust codes become more stringent, the high mechanical collection efficiency of the Valmont Type S becomes more important. Due to a series of design improvements, the Valmont Type S Tube offers improved aerodynamic flow, increased capacity per tube with resulting decrease in space requirements, weight and price.

Valmont Type S Tubes are shipped in "uniblocs" of 15, 20 or 25 tubes each, materially reducing erection costs.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

(Offices in 28 principal cities)

Canadian Affiliates:

T. C. CHOWN, LTD., 1440 St. Catherine St. W., Montreal 25, Quebec

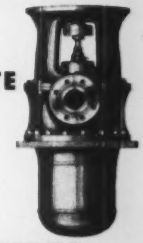
PRAT-DANIEL CORPORATION

77-3 WATER STREET **EAST PORT CHESTER, CONN.**

DESIGNERS AND MANUFACTURERS OF POWER PLANT EQUIPMENT FOR OVER 25 YEARS

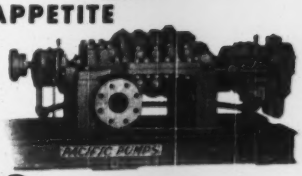
Pacific

Precision Built FEED PUMPS *Satisfy* YOUR BOILER'S APPETITE*



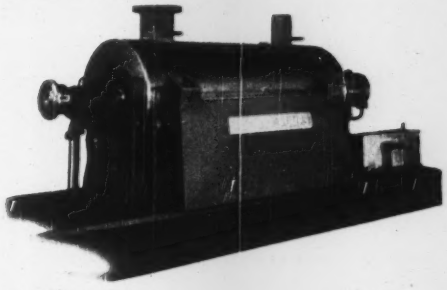
*** FOR THE SMALL APPETITE**

19,000 to 165,000 lbs. per hour
VERTICAL—TYPE WBF
DISCHARGE PRESSURES: 100 to 2000 PSI



*** FOR THE MODERATE APPETITE**

45,000 to 475,000 lbs. per hour
TYPE JBF
DISCHARGE PRESSURES: To 1000 PSI



*** FOR THE PRODIGIOUS APPETITE**

To 1,200,000 lbs. per hour
TYPES ABF and IBF
DISCHARGE PRESSURES: To 3000 PSI

TAILORED TO YOUR SPECIFIC BOILER NEEDS PACIFIC FEED PUMPS ALSO SATISFY:

YOUR PLANT ENGINEERS . . . because they require minimum attention and maintenance; because they are precision-built from materials selected for high resistance to corrosion-erosion and because they are balanced dynamically and hydraulically to eliminate vibration and excessive wear.

YOU, THE OWNER . . . because of their dependability; sustained efficiency and low cost of operation and maintenance.

PACIFIC *Precision Built* **PUMPS**

Write for Bulletin 109

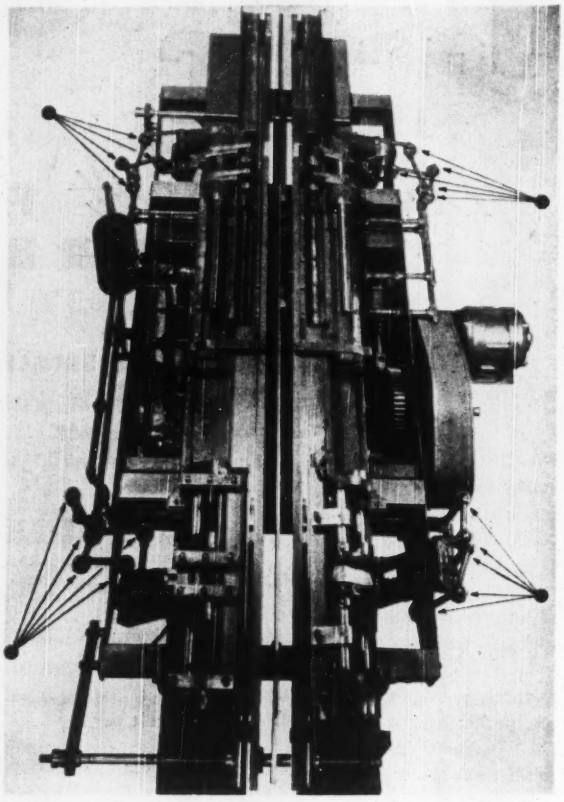
Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York ★ *Offices in All Principal Cities*

BF-5

FLEXIBLE JOINT ADAPTABILITY for all services



This Can-Flaring machine uses Barco (extra heavy) Swivel Joints to keep its fluid lines flexible.

Providing such flexibility is no unusual job for Barco Joints. They perform many services on a wide variety of machines and fluid conveying systems, both simple and complex. Barco Joints are made to withstand hydraulic pressures of 2500 pounds. They are unique in their ability to absorb shock and misalignment strains, due to a combination ball and swivel action.

Throughout the last 41 years, Barco engineers have solved thousands of problems relating to flexible connections. Their experience and technical skill are at your disposal. Write Barco Manufacturing Co., 1807D Winnemac Ave., Chicago 40, Ill. In Canada: The Holden Co., Ltd., Montreal, Canada.

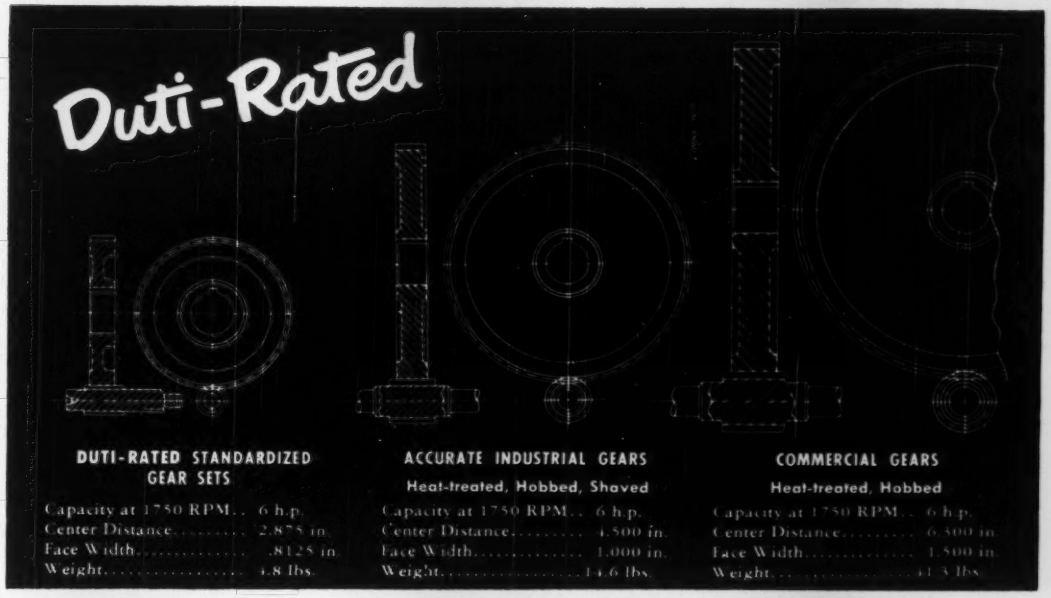
CAN-FLARING MACHINERY USES BARCO SWIVEL JOINTS (EXTRA HEAVY)

BARCO FLEXIBLE JOINTS

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

Not just a swivel joint ...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

"MOVE IN EVERY DIRECTION"



GEAR SETS RATED TO YOUR JOB

A MAJOR ADVANCE IN GEAR APPLICATION

SPECIFIC APPLICATION OF DUTI-RATED GEARS

In the analysis of a specific application, the Foote Bros. **Duti-rated** *Gear Set of 60 Rockwell C Hardness made by the* **Duti-rated** *process method, was able to do the work of an accurate industrial gear set made to a heat-treated, hobbed and shaved construction in 64% of the center distance and 33% of the weight. This same gear set was able to do the work of a commercial grade gear set of heat-treated and hobbed construction in 46% of the center distance and 12% of the weight.*

Foote Bros. has now made available to designing engineers and equipment builders a new product—Standardized precision **Duti-rated** Gear Sets that may be as conveniently selected as antifriction bearings. Sizes range from 1 h. p. through 200 h.p. with a wide selection of ratios and center distances. **Duti-rated** Gears are available in helical sets (parallel shafts) and worm gears (right angle drives).

These gear sets may be directly applied to the solution of your gear problems with all the available factors of life, load and type of service taken into consideration. They are pre-engineered, produced under most exacting controls and pre-tested to meet your requirements.

Duti-rated Gears offer new advances in gear production achieved through improved design, new manufacturing processes, the most advanced standard and special facilities, and better control of methods and heat-treatment. **Duti-rated** Gears represent a new conception in gear accuracy and precision. File hard tooth surfaces and tough, resilient cores give more load carrying capacity—longer wear life.

Duti-rated Gears bring you these advantages:

Simplified and dependable gear selection.
Cost saving of from 10% to 50% or more.
Standards of accuracy never before commercially available.
High mechanical efficiency.
Important space and weight savings in gears and related parts.
Quiet operation.
Quickly available.

Every engineer and every builder of equipment should learn more about this advanced method of gear selection and application. Mail the coupon for engineering manual DRA today.

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
Dept. Q 4545 South Western Blvd., Chicago 9, Illinois

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 S. Western Boulevard
Chicago 9, Illinois

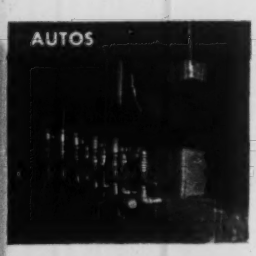
I am interested in the application of standardized **Duti-rated** Gear Sets. Please send me Engineering Manual DRA.

Name.....
Company.....
Position.....
Address.....
City..... *State*.....

WHAT ARE YOU PAYING *for Condensate?* $ $ $ $

If your steam heated equipment is not supplied with hot, dry steam kept in intimate contact with the heated surface and free from air, you are paying for fuel that is being thrown away every hour.

Worse yet, you are paying double in lost production and rejects, if your equipment is not properly trapped and vented.

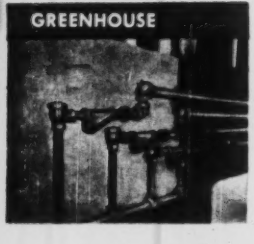


$ LOST TIME

Heating up time was reduced from 3 hours to 1 by using Sarco No. 9 Thermostatic Traps on enamel ovens in a large auto body plant. This trap has large air venting capacity. Removes condensate at 10°F below steam temperature.

$ REJECTED GOODS

With seven platens on this large plastics press, the weakest link (one cold section) made rejects frequent and without notice. Now seven Sarco Bucket Traps kick out the condensate and provide trouble-free production. This trap is ideal for releasing condensate as quickly as it forms—a must on plastics presses.

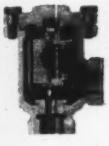


$ LOST FUEL

Most manufacturers don't know how much fuel they are losing due to inefficient trapping. In greenhouses, where fuel is a large part of the cost, monthly fuel bills tell the story fast. This greenhouse saved 30% of the fuel and 60% of the make up water by using Sarco Thermostatic traps on every line and every coil.

FOUR TYPES OF SARCO STEAM TRAPS TO CHOOSE FROM

Sarco makes all accepted types and can fit the trap to the job. Ask for trap selection chart No. 1600.



FLOAT-THERMOSTATIC

THERMOSTATIC

BUCKET

LIQUID EXPANSION

259

SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

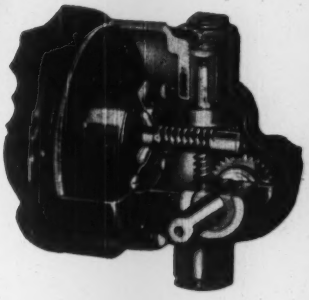
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

New!

SIMPLE... COMPACT

Built to LAST!



NOW you can get

R & M PERFORMANCE

IN GEAR HEAD MOTORS, TOO!

● Here's *good news* for designers of small power-operated equipment. Now you can get Robbins & Myers Gear Head Motors in *fractional-horsepower* ratings. You'll like their compact construction—neat appearance—*easy-to-use* convenience. And their on-the-job stamina means freedom from maintenance that *users* are sure to appreciate.

SINGLE AND DOUBLE REDUCTIONS
(Ratings above 1/20 h. p. in Universal-Type Motors, only.)

MOTORS: 1/200 to ⅓ h. p.

COUNTERSHAFTS: 800 to 2 r. p. m.

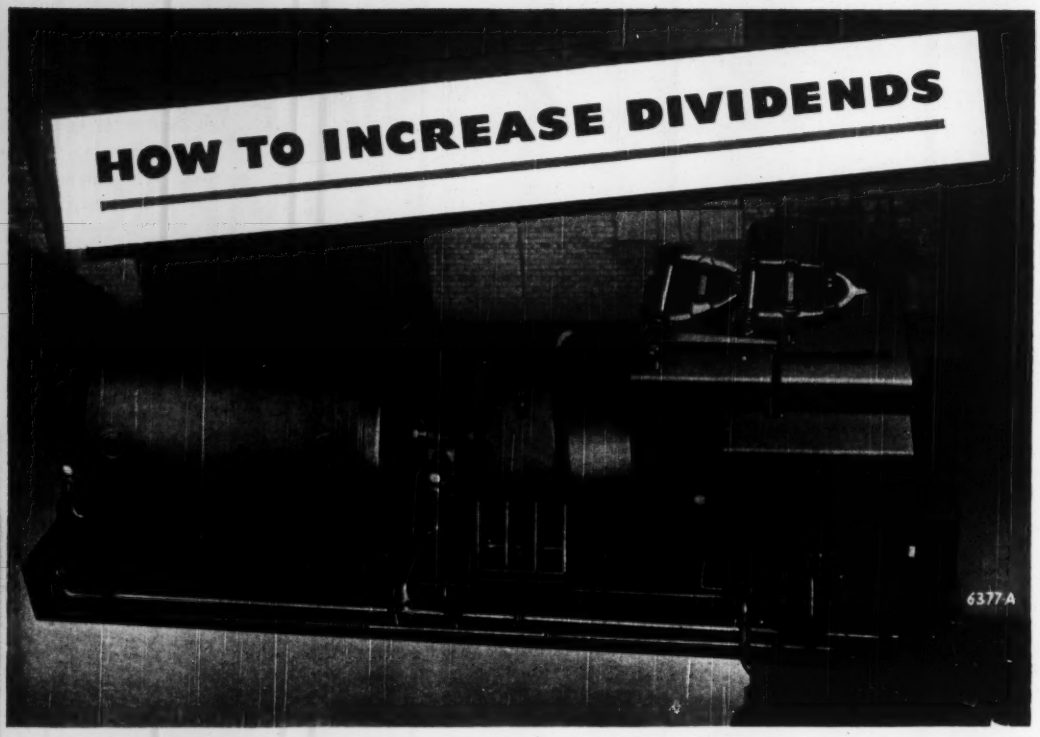
TORQUE RATINGS: 1 to 6 in. lbs.

Write for literature. Address Dept. F-30

These new units are functional—quality-built—with the *economies* of standardization. Motor ball bearings are double-sealed—require no lubricating in normal service for at least *five years*. Rotors are dynamically balanced for smooth and quiet operation. Worms are induction-hardened for *long-lasting* high wear value. Gears are precision-machined for uniform load distribution. From welded-steel motor shell to die-cast gear box, each element is typically "*Robbins & Myers.*"

Countershafts may project in any of several directions with respect to the base, for direct-connecting or other forms of power take-off. Motor types meet *every* service need. R & M Gear Head Motors are something *you* should know about now! Get all the facts today.

ROBBINS & MYERS · INC. MOTOR DIVISION
Springfield 99, Ohio • Brantford, Ontario



Ask your consulting engineer about the economy of producing power as a by-product!

When steam is required for heating or processing, the cost of producing *power* as a by-product is so low that it is not unusual for the installation of a modern De Laval Turbine Generator to realize savings of as much as one-tenth or one-quarter of a company's total paid out dividends.

Why not sit down with your consulting engineer and make a careful study of your present power plant. It may pay dividends for your company too!

For preliminary information send for Catalog 4205-28-A.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

DE LAVAL

T-28

a beautiful
school for Kalamazoo

a fine
steam heating plant
by **WICKES**

The choice of progressive architects and engineers everywhere, Wickes Package Water Tube Steam Generators will be installed in this completely modern junior high school at Kalamazoo, Michigan. This imposing group of buildings will have a total of 40 classrooms with facilities for 1200 pupils. It is scheduled for completion in 1950 and will take its place as one of the finest junior high schools in the country. Classroom comfort is an important factor in any school, and the three oil fired Wickes Package Water Tube Boilers, equipped with stub stacks and induced draft fans for efficient, economical operation, can be relied upon for an uninterrupted flow of heat every minute of the school day.

Louis C. Hegemier & Associates, Inc.
Architects and Engineers
Kalamazoo, Mich.

C. L. Mahaney
Heating Contractor
Kalamazoo, Mich.

Miller-Davis Co.
General Contractor
Kalamazoo, Mich.

WICKES

THE WICKES BOILER CO.
SAGINAW, MICHIGAN, U.S.A.
DIVISION OF THE WICKES CORPORATION

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Fort Worth, Texas • Indianapolis • Jacksonville
Los Angeles • Milwaukee • New York City • Peoria, Ill. • Pittsburgh • Saginaw • San Francisco • San Jose, Calif. • Seattle • St. Louis
Tulsa, Okla. • Mexico City • RECOGNIZED QUALITY SINCE 1854.

NO ONE MAN, we'd bet. There's a look of "divided responsibility" about that job. And that's our point.

When you want a good air conditioning system, specify a Carrier installation throughout. It stands to reason that your client will get a better job. Carrier components are designed to go together. They're all built to exacting standards. There's no "weak link" in a Carrier installation.

That's why we say specify Carrier throughout. If you do, there's no chance of anybody saying, "Who done it?"

To satisfy customers, just remember that every significant advance in air conditioning in the last half century has come from Carrier. These are a few of the Carrier products available: Conduit and Duct-type Weathermaster systems for the multi-room building; Evaporative Condensers; Central Air Conditioners; Dehumidifiers; Self-contained Air Conditioners; Reciprocating, Centrifugal and Absorption Refrigeration Machines; Cold Diffusers and Heat Diffusers. Carrier Corporation, Syracuse, New York.

Carrier AIR CONDITIONING • REFRIGERATION • INDUSTRIAL HEATING

"Special equipment" usually spells higher costs for the customer. But when SK engineered this special condenser for a Pennsylvania paper mill, the result was a *three-way saving!*

SK engineers were asked to design a condenser for heating process water from 90° to 110° F. at a rate of 550 gpm, using steam at atmospheric pressure. A standard SK 30" Spray-type Counter-current Heating Condenser met the capacity requirements. However, a cast iron unit was too heavy for a roof installation without using costly weight-distributing support plates plus expensive rigging to raise the unit to the roof.

To meet requirements, SK *engineered* the solution by fabricating a condenser of ¼" semi-hard aluminum plate. This condenser not only met specifications, but in addition saved the customer money in three ways:

1. Support plates were unnecessary for the lighter unit (about 1/6 the weight of a cast iron condenser).
2. Expensive rigging was eliminated by taking the lighter condenser to the roof in the freight elevator in two sections.
3. Cost of the special aluminum unit was actually *less* than the standard cast iron condenser.

Schutte and Koerting, with over seventy years' experience as Manufacturing Engineers, have the problem-solving ability to meet *your* power or processing requirements. In recommending a *standard* SK product — or engineering a *special* unit — our aim is to give you the most efficient equipment at the lowest possible cost.

For *engineering* and *manufacturing* service that saves you money, write us today, describing your power or processing needs.

SCHUTTE and KOERTING Company

Manufacturing Engineers

1166 THOMPSON STREET • PHILADELPHIA 22, PA.

JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • ROTAMETERS • FLOW INDICATORS • RADIAFIN TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

Any Speed YOU NEED

WITH

GEARMOTOR

. . . because it is available in single, double or triple reductions, offering a range of speeds: 780 through 7.5 r.p.m. Motor rating from 1 h.p. through 60 h.p.—A-c or D-c. The motors and gear units are each self-contained and readily separated . . . gears in multi-reduction units may be inspected, without uncoupling from driven machine.

These small, compact, self-contained units simplify the direct application of electric drive to individual machines.

GearMotoR conforms to the recommended standards of the American Gear Manufacturers Association and the National Electrical Manufacturers Association.

Send for 42-page Illustrated catalog, containing full information and data necessary for ordering, and please use your Business Letterhead when requesting same.

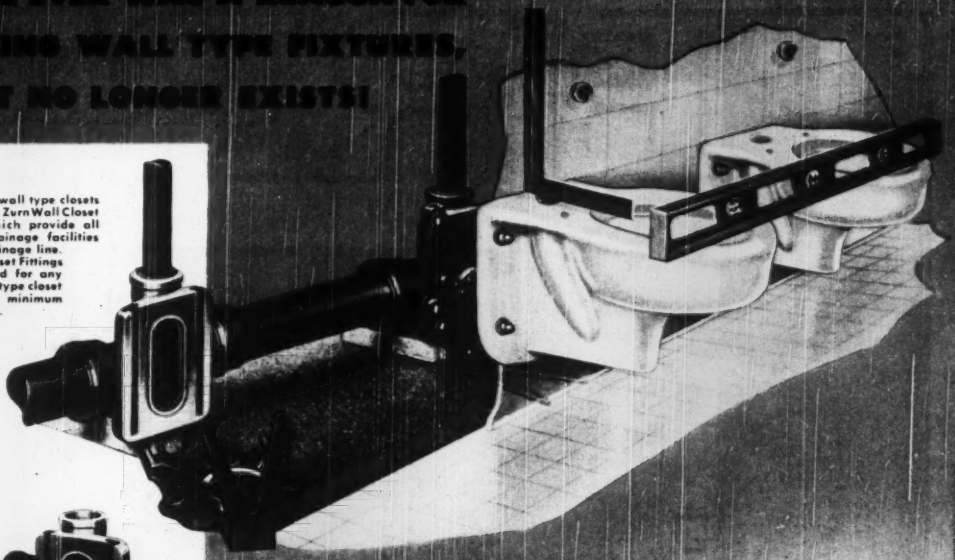
Philadelphia Gear Works, INC.

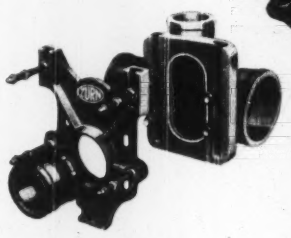
ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

IF THERE EVER WAS A REASON FOR NOT USING WALL TYPE FIXTURES, IT NO LONGER EXISTS!

A battery of wall type closets installed with Zurn Wall Closet Fittings, which provide all necessary drainage facilities up to the drainage line. Zurn Wall Closet Fittings are designed for any make of wall type closet and require minimum of wall space.





Horizontal adjustable wall closet fitting. Figure Z-1205-SHR4.

ZURN *Found*

the Simple, Fast, Safe Way to Install Wall Type Plumbing Fixtures

Wall type fixture plumbing gets fixtures up off the floor—marks a new era in sanitation. Clear, unobstructed floor areas make for neater, cleaner rest rooms. Washing or sweeping a floor is done more quickly, easily, economically. Wall type fixture plumbing reduces cost of rest room maintenance. Only the use of wall type plumbing fixtures protects toilet facilities against premature obsolescence.

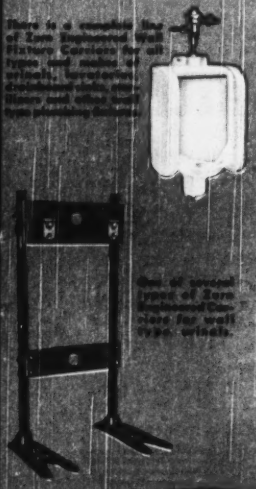
Zurn Wall Closet Fittings and Wall Fixture Carriers are engineered to support wall type fixtures—off the floor, free of the wall—safely, securely and in permanent alignment. All necessary adjustments are simple; assembly and installation are fast—no mistakes, delays or grief on the job.

Zurn Wall Closet Fittings and Wall Fixture Carriers fit all types and makes of wall closets and wall type fixtures. Consult a Zurn representative for more details.

J. A. ZURN MFG. CO. PLUMBING DIVISION
ERIE, PA., U.S.A.

SALES OFFICES IN ALL PRINCIPAL CITIES

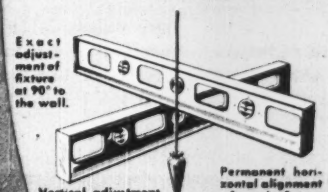
When, where and how to install wall type fixtures is thoroughly presented in the new Zurn "Carrier Catalog and Handbook"—virtually a manual for specifying, buying and installing wall type fixture plumbing. Order a copy now! You'll be needing it! No charge to architects and engineers and contractors.



THE ZURN WAY

PERFECT ALIGNMENT IN ALL 3 DIRECTIONS

Obtained with Exclusive Adjustment Features of Zurn Wall Closet Fittings And Carriers....For The Support of All Types And Makes of Wall Type Fixtures



Exact adjustment of fixture at 90° to the wall.

Vertical adjustment of fixture to any required height from the floor.

Permanent horizontal alignment of each fixture with all others.

ZURN

Carrier Catalog and Handbook No. 50

J. A. ZURN MANUFACTURING CO. • PLUMBING DIVISION • ERIE, PA., U.S.A.

Please send me the new Zurn "Carrier Catalog and Handbook" No. 50 for wall type plumbing fixtures.

Name and Title .....

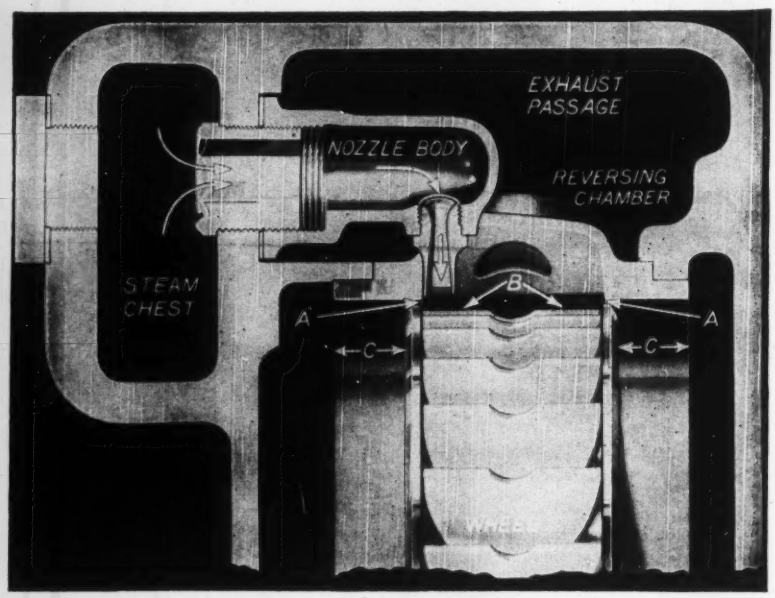
Company .....

Street .....

City and State .....

Please attach coupon to your business letterhead. Dept. M¹

TERRY



AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

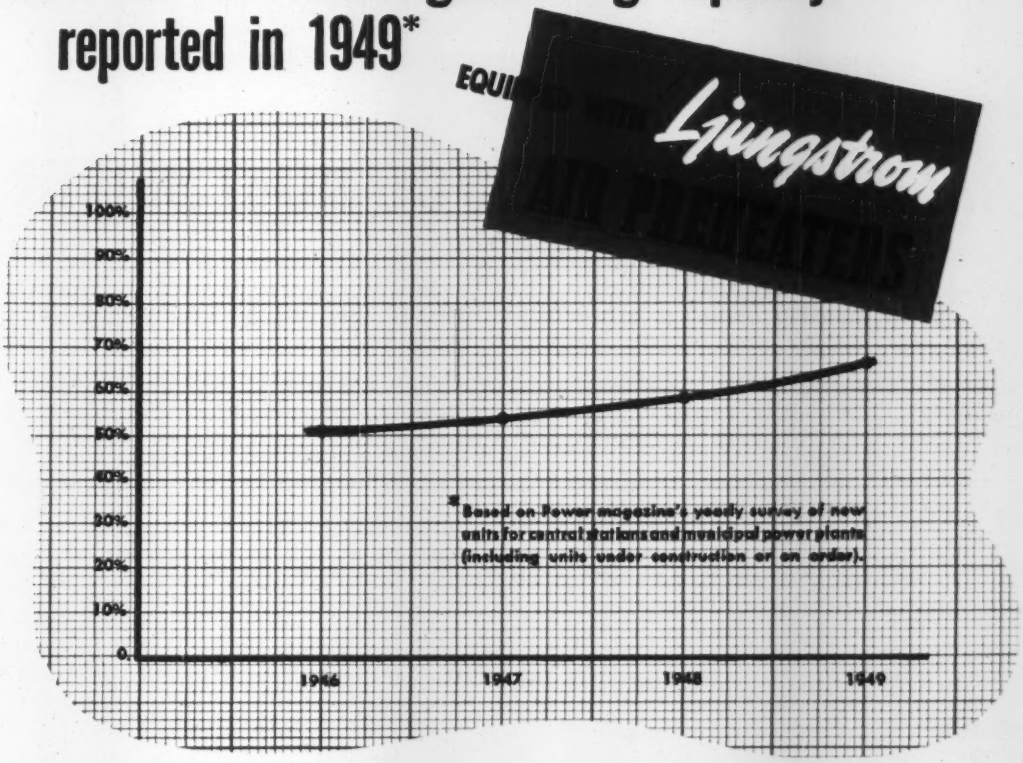
Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Over 65% of steam generating capacity reported in 1949*



Again in 1949 utilities continued to register an increasing preference for the Ljungstrom regenerative air preheaters. Over 65% of the steam generating capacity for central stations and municipal power plants (including units under construction or on order) reported in Power magazine's 1949 Modern Plant Survey will be equipped with Ljungstrom air preheaters.

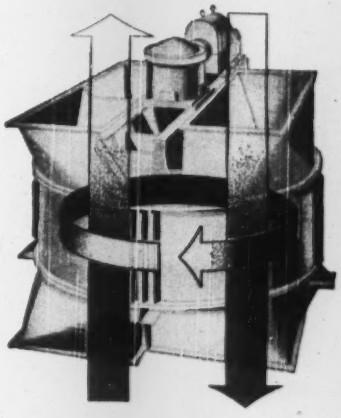
The reasons behind this wide acceptance of the Ljungstrom, the only regenerative type air preheater, are sound and simple:

1. High Heat Recovery: The Ljungstrom air preheater, by employing the continuous regenerative counterflow principle, assures the highest practical heat recovery, up to 70% of the total heat in the stack gases.

2. Low Operating Costs: The regenerative principle provides accurate control of metal temperature throughout the entire unit. This permits operation with low maintenance costs, under conditions which would cause rapid deterioration in other designs.

3. Reliability: The high availability of the Ljungstrom air preheaters with all types of boilers, under every condition of operation, is a matter of record in power plants throughout the country.

THE AIR PREHEATER
60 EAST 42d STREET • NEW YORK 17, NEW YORK
CORPORATION



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

WHETHER YOU MAKE AXLES

OR XYLOPHONES

AIR BY "Buffalo" HELPS YOU DO IT BETTER

NEED humidity control to halt rust? Looking for a cheaper way to convey materials? Want to remove corrosive gases from a continuous process? Striving for a better product and more of it? Better industrial relations? Lower accident rate? All these and many other air jobs are being done throughout industry by "Buffalo" Fans and Air Conditioning Units. "Buffalo" units will work quietly, day and night, in your plant — removing impurities, tempering, ventilating, cooling or heating — providing the atmosphere in which your product and your personnel can be at their best.

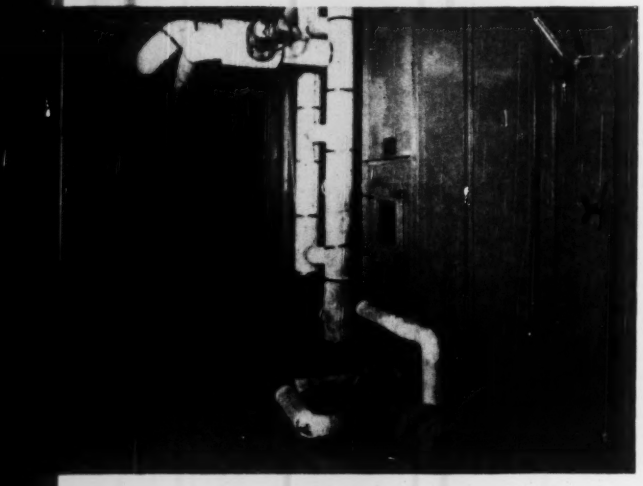
BUFFALO FORGE COMPANY

148 MORTIMER STREET BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" FANS AND AIR CONDITIONING

Branch Offices in All Principal Cities



AIR CONDITIONING — OR SIMPLE VENTILATION?

"Buffalo" Air Conditioning Units can create and maintain literally any "climate" your plant requires—efficiently and at a very reasonable operating cost. Above, an air washer removes dust and humidifies a large plant. Many "Buffalo" Air Washers have been continuously on the job for over forty years.

A good, reliable fan like this "Buffalo" Limit-Load model might well provide all the cooling and general air comfort for your plant needs—when other air processing is not called for. Many "Buffalo" Fans have been on the job for forty, fifty and more years. The "Buffalo" line is COMPLETE—to suit any budget, any requirements.

YOUR NEARBY "BUFFALO" ENGINEERING REPRESENTATIVE

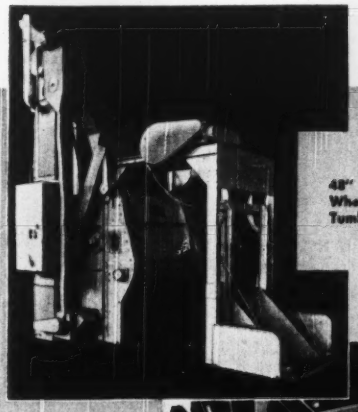
will give you recommendations — based on your problem and your budget — on turning your plant air to profitable use. He's a Graduate Engineer with 1-5 years of factory training. He's yours to call on, with no obligation.

MORE GOOD EXAMPLES of DIAMOND ROLLER CHAIN Use

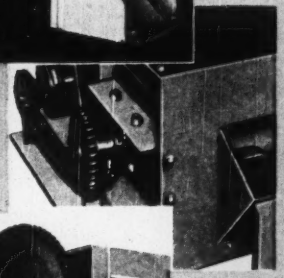
• For years American Wheelabrator & Equipment Corp. of Mishawaka have found good use for Diamond Roller Chain on various machines of their manufacture. Such long-hour operation machinery as Wheelabrators necessarily require ruggedness and reliability of all components. And for Sandcutters, the Chain must operate in the presence of heavy dust and grit.

These are but a few more examples of Diamond Roller Chains in use throughout industry—good evidence of adaptability and performance.

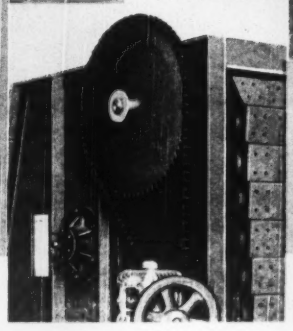
DIAMOND CHAIN COMPANY, Inc., Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Ind. *Offices and Distributors in All Principal Cities.*



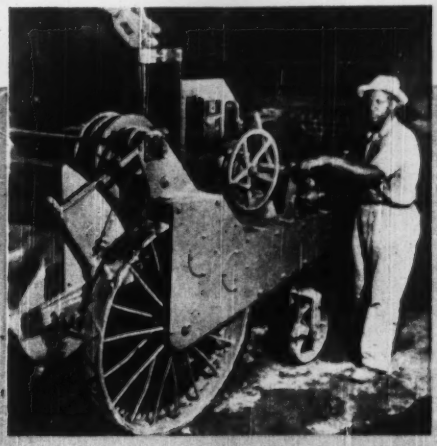
48" x 22" Wheelabrator Tumblast

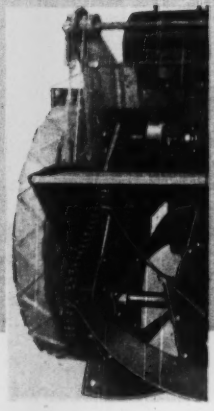


Abrasive screen drive on Wheelabrator Tumblast shown at right.



Left: Diamond Roller Chain drive to upper rear conveyor shaft of Tumblast.



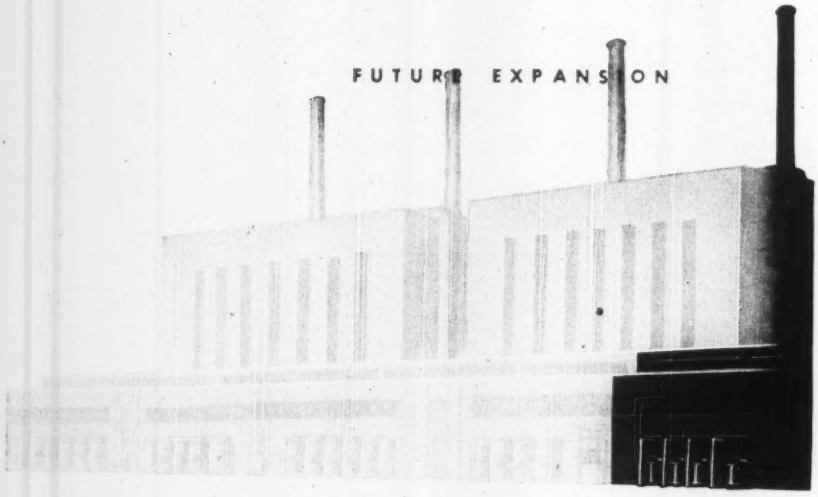


Above: American "AM" Sandcutter with close-up view of Diamond Chain cutting cylinder drive.

DIAMOND ROLLER CHAINS

a tradition of leadership

On the evening of July 4th, 1883, Thomas A. Edison placed in operation the first three-wire central station electric lighting plant in the world at Sunbury, Pa. Power was supplied to the old City Hotel three blocks away which was then on the site now occupied by the Hotel Edison.



The world's largest power plant using pulverized anthracite has been completed recently on a site near Shamokin Dam along the Susquehanna River about two miles below Sunbury, Pa. This 150,000 kw installation, first of a number planned for the site, is part of the Pennsylvania Power & Light Company's network serving 28 counties which cover an area of 9,500 sq miles in central eastern Pennsylvania.

The two 75,000 kw turbine generators are served by four 130-ft high Foster Wheeler Steam Generators, the largest ever built for direct firing of pulverized anthracite.

An extension of 100,000 kw capacity, now under construction, will be completed in 1951 and equipped with Foster Wheeler Steam Generators.

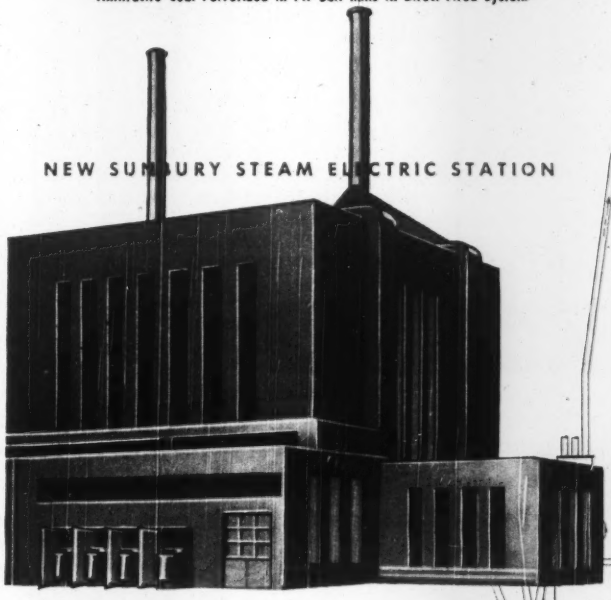
FOSTER WHEELER CORPORATION · 165 BROADWAY

[redacted]

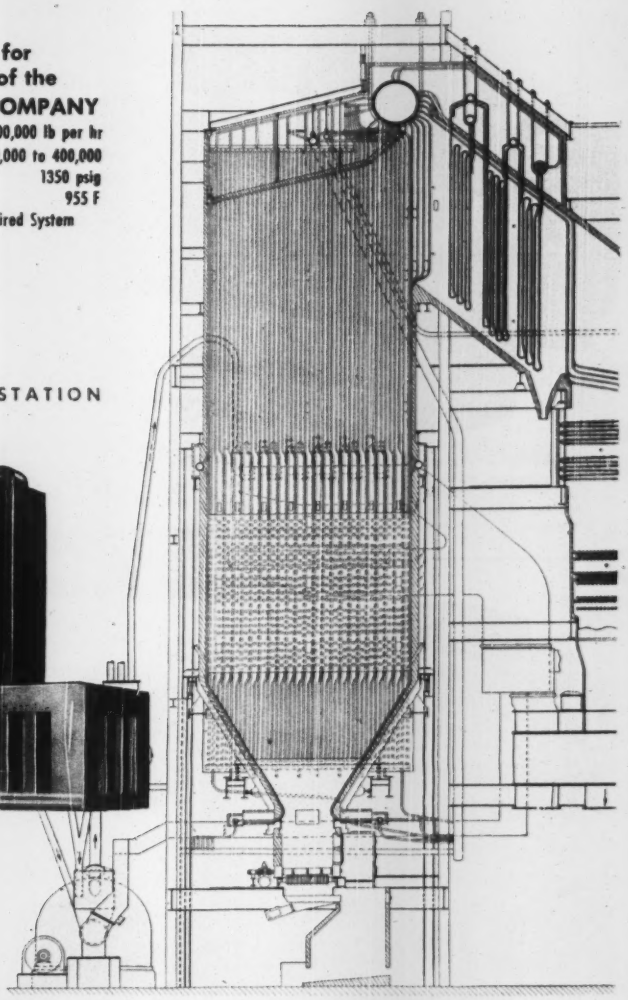
Four FOSTER WHEELER Units for Sunbury Steam Electric Station of the PENNSYLVANIA POWER & LIGHT COMPANY

Capacity	400,000 lb per hr
Superheat Control Range	250,000 to 400,000
Pressure Superheater Outlet	1350 psig
Final steam Temperature	955 F

Anthracite Coal Pulverized in FW Ball Mills in Direct Fired System



NEW SUNBURY STEAM ELECTRIC STATION



Each steam generator is equipped with two Foster Wheeler ball mill pulverizers which have a combined output of 27 tons of coal per hr.

[redacted]

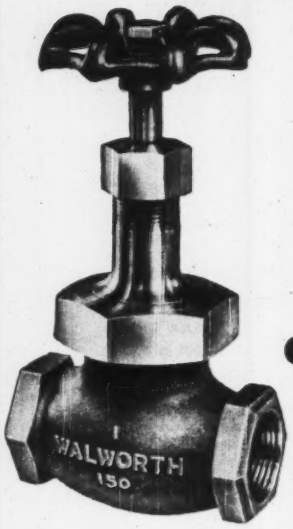
NEW YORK 6, N. Y.

WALWORTH

Toothed Lock Washer: Prevents loss of stem nut due to vibration, thereby holding the handwheel securely.

Newly Designed Handwheel: Air-cooled, finger grip handwheel affords sure grip even with greasy gloves.

Improved Packing: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure.

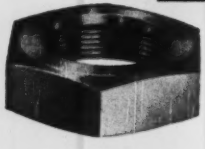


IMPROVED
No. 95
BRONZE
GLOBE VALVE

also available in Angle Type (No. 96)

The service ratings of the Walworth No. 95 are 150 pounds per square inch steam at 500F, and 300 pounds per square inch non-shock cold water, oil, and gas. In the manufacture of this quality bronze valve, more than 47 gages are used in machining parts to micrometric accuracy, thus insuring interchangeability of parts. For further information see your local Walworth distributor, or write: Walworth Company, 60 East 42nd St., New York 17, N. Y.

note these 7 Great Features



Hexagonal Union Bonnet Connection: Eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and assembled.

WALWORTH
valves and fittings

60 EAST 42nd STREET NEW YORK 17, N. Y.

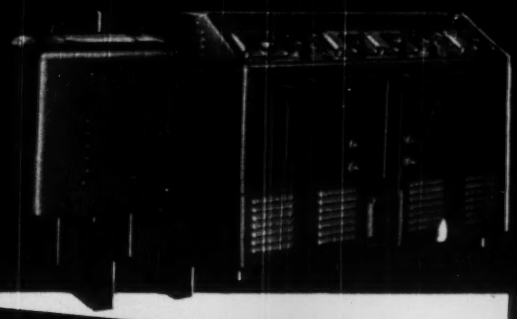
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

New Cylindrical Disc Holder: The design of the top portion of the disc holder keeps the disc accurately guided under all operating conditions.

Renewable Asbestos Disc: This disc is suitable for steam up to 500F and is resistant to oil, gasoline, and many chemicals at atmospheric temperatures. Discs for special services are available.

Extra Strong Body: Made of Composition M (ASTM B61) bronze thick enough to provide a high safety factor. Valves undergo hydrostatic shell test of 450 psi.

Power Unit with cabinet removed; valves are gasket mounted to simplify installation, save space, improve machine appearance.



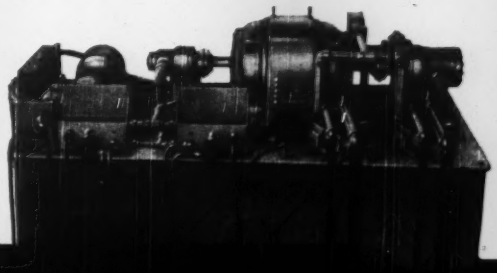
Power Unit having pump driven by standby gasoline engine.

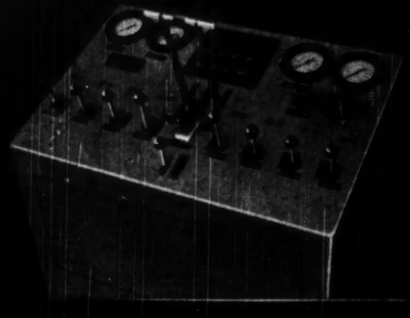
VICKERS Hydraulic POWER UNITS *Custom Built*

Illustrated here are representative examples of the infinite variety of self-contained hydraulic power Units that are designed and built by Vickers for the more efficient operation of many kinds of machinery. These compact Units include all necessary pumps, valves, intermediate piping, reservoir, hydraulic accessories, motors and controls. Hydraulic connections to the machine are grouped in a convenient manifold.

Design is simplified because arrangement is not limited by structure of machine. Installation time and cost are substantially reduced because all hydraulic equipment is received as a self-contained "package" instead of separate parts that must be individually installed. Every Unit is pretested at factory and is ready for immediate operation. Cabinets which are optional, blend well with modern machine design. Operating adjustments and maintenance are simplified by convenient layout and gasket mounted valves. Vickers Custom Built Power Units have other important advantages ... ask for Bulletins 47-45 and 46-43.

- **Simplify Design**
- **Reduce Installation Costs**
- **Improve Appearance**
- **Save Time**
- **Easier Maintenance**





Power Unit is placed in base of machine . . . console control where convenient to operator.

VICKERS
Incorporated
DIVISION OF THE SPERRY CORP.

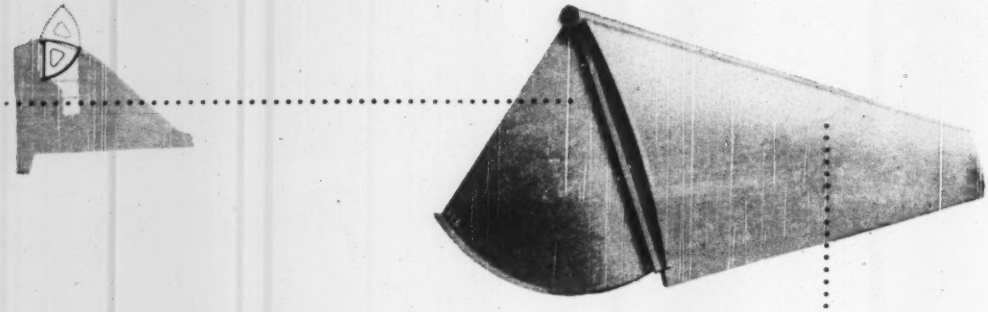
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Application Engineering Offices: **ATLANTA • CHICAGO • CINCINNATI CLEVELAND • DETROIT • HOUSTON • LOS ANGELES (Metropolitan) MILWAUKEE • NEW YORK (Metropolitan) • PHILADELPHIA • PITTSBURGH • ROCHESTER • ROCKFORD • ST. LOUIS • SEATTLE • TULSA WASHINGTON • WORCESTER**

ONE OF A SERIES DEMONSTRATING APPLIED LUKENOMICS

LIFE-TIME GATE GUARANTEE...or how to make

submerged steel structures last longer, work better, cost less



To provide 4 feet of adjustable control at the top of a 12-foot concrete spillway section, the Huron-Clinton Metropolitan Authority specified a 90-foot drum gate. The final design called for fabrication of three 30-foot all-welded water-tight sections using nickel-clad parts where difficult to paint or when subjected to corrosion or wear. The structure provided maximum stiffness, minimum weight, ease of operation, excellent appearance and an assurance of long trouble-free life.

Benefits like these come from looking beyond mere structural design toward considered materials buying, accurate evaluation of fabrication and erection costs, appearance requirements and a host of similar factors. Such an approach to the *total* problem posed in engineering structures or equipment we term Lukenomics. Lukenomics brings to bear not only Lukens own products, services and knowledge of materials but marshals, as well, industry's skilled consultants, structural shops and equipment manufacturers.

To obtain the advantages of structures or equipment designed or fabricated in accordance with the Lukenomics principle, write our Manager of Marketing Service, Lukens Steel Company, 402 Lukens Building, Coatesville, Pennsylvania.

This drum-type gate structure was fabricated by R. C. Mahon Company, of Lukens Nickel-Clad Steel and erected at Kent Lake Dam on the Huron River, a recreational area under development by the Huron-Clinton Metropolitan Authority of Michigan. Ayres, Lewis, Norris & May, consulting engineers.

LUKENS

LUKENS STEEL COMPANY

BETTER PRODUCTS FOR BETTER EQUIPMENT

A-6648

You can record torques instantaneously with the BRUSH Strain Analyzer

● Here's a strain measuring device that gives you *immediate, accurate* records of static or dynamic phenomena . . . for your interpretation . . . and for permanent proof of results.

The Brush Strain Analyzer provides these advantages for a rapidly growing list of enthusiastic users, for a wide variety of applications.

The picture shows Professor D. K. Wright, Jr. of the Mechanical Engineering Department of Case Institute of Technology, using this Brush Analyzer to record the torque of an engine equipped with fuel economizer. Professor Wright reports that the Brush Strain Analyzer is used at Case for research and tests involving torque, strain, vibration, pressure and other physical variables.

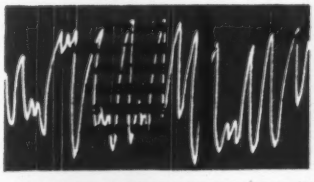
Find out how *you* can benefit from the accurate measurements and *proven* results made possible by Brush Analyzers.

Write today for information.

THE *Brush* DEVELOPMENT COMPANY

3405 Perkins Avenue, Cleveland 14, Ohio, U.S.A.

Canadian Representatives: A. C. Wickman (Canada) Ltd., P. O. Box 9, Station N, Toronto 14, Ontario

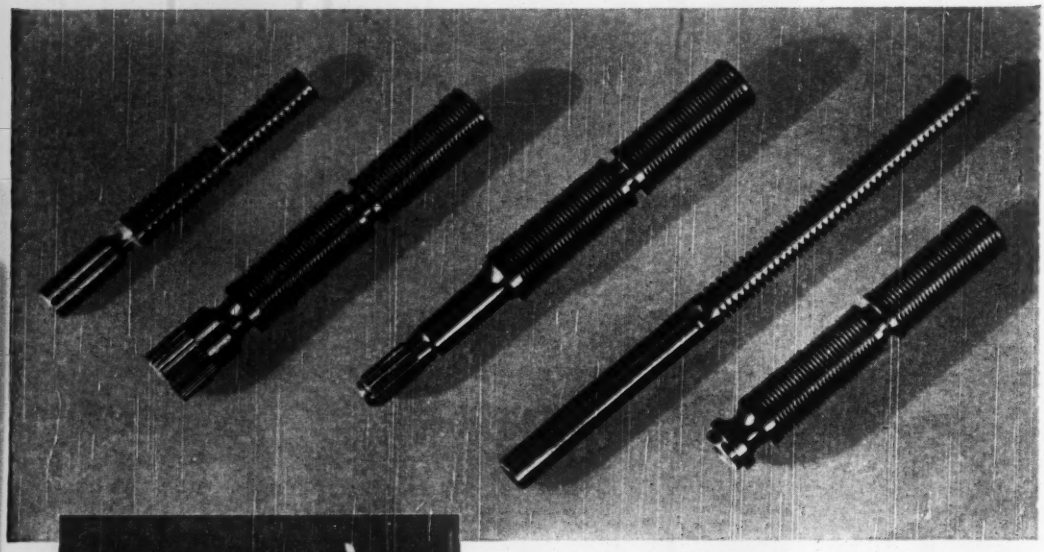


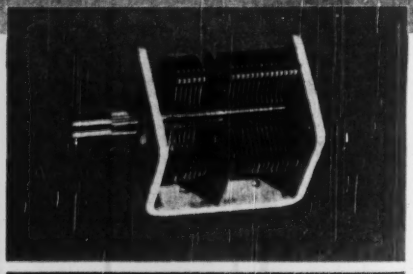
it in writing with a

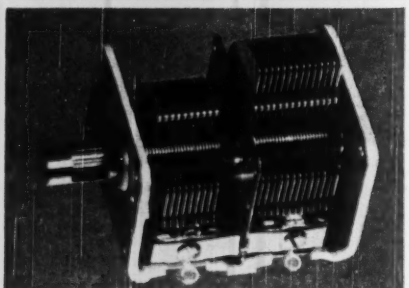
BRUSH RECORDING ANALYZER

STRAIN ANALYZERS • SURFACE ANALYZERS • CONTOUR ANALYZERS • UNIVERSAL ANALYZERS • UNIFORMITY ANALYZERS

For Tough Machining Jobs, Get REVERE FREE-CUTTING BRASS







Above, Model CS, smallest condenser, air space .009". Below, Model B, largest, air space .013". Rotor shafts, shown in top illustration, are Revere Free-Cutting Brass, plates aluminum. Made by The American Steel Package Co., Defiance, Ohio, an important supplier to the electronics industry.

HERE are several examples of the fact that Revere Free-Cutting Brass is really good. These rotor shafts for variable condensers are cut on automatic machines at 3600 r.p.m. Circular tools are used to cut the concentric slots which are .050" deep. Only one cut has to be taken. Approximately 425 pieces are produced per hour on a 6-second cycle. The American Steel Package Company, Defiance, Ohio, produces a number of different condenser models, with air spacing ranging from .009" up to .042". The slots in the shaft of Revere Free-Cutting Brass are all of the same width, regardless of air spacing, namely .014" plus or minus .0002". It takes good machines, good tools, good men, and good metal to work that closely. A report from a Revere Technical Advisor who had collaborated with the company states: "Customer is outstanding in his praise of Revere Rod." . . . If you have a problem in the machining of brass, why not give Revere an opportunity to work with you? The Revere Technical Advisory Service is at your command.

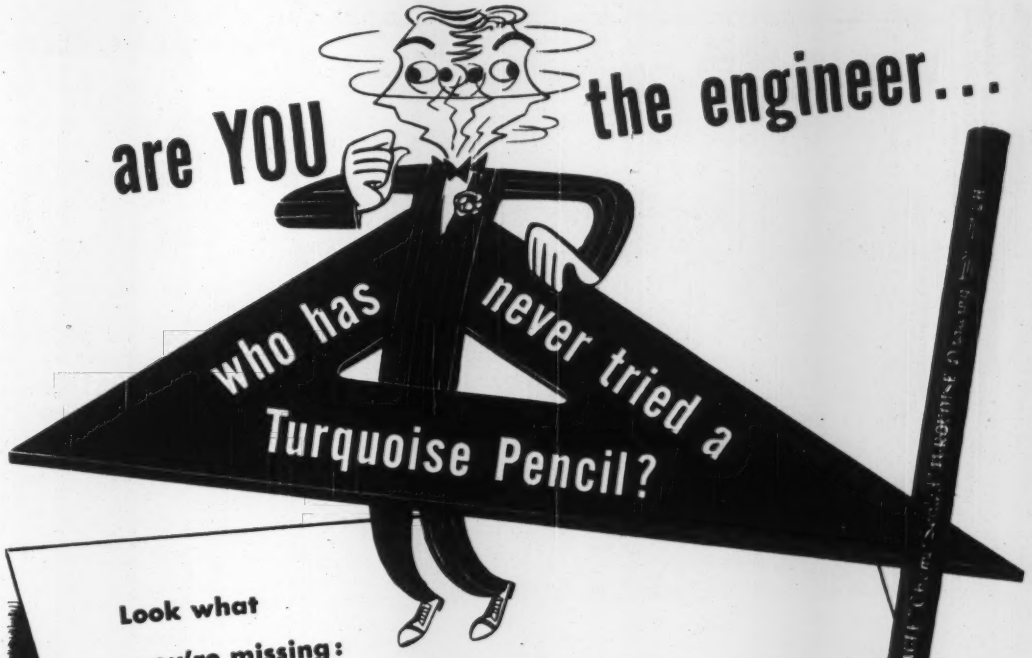
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.



Look what you're missing:

- **STRONG POINTS** that stand up when you bear down
- **SMOOTHNESS** that speeds your work
- **PRECISION GRADING**—6B to 9H—accurately spaced
- **DURABILITY** that saves you time and money
- **OPACITY** for sharp lines and legible blueprints
- **CLEAN ERASURES** that leave no "ghost lines"

FREE TEST SAMPLE

Just write us, name this magazine and your regular pencil dealer, and we will send you a Turquoise Pencil in any grade you specify. Eagle Pencil Co., 703 E. 13 St., New York 9, N. Y.

EAGLE

*"CHEMI-SEALED" SUPER BONDED

*TURQUOISE

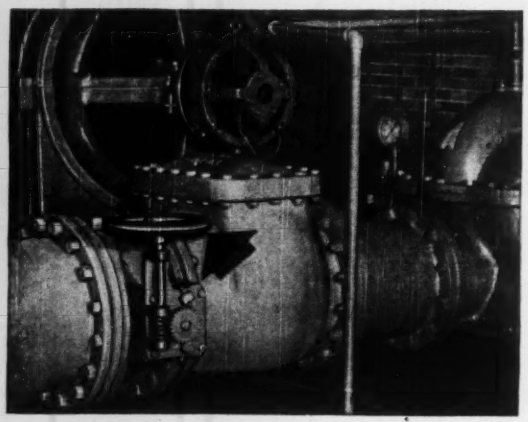
DRAWING PENCILS AND LEADS

*Reg. U. S. Pat. Off.

EAGLE PENCIL COMPANY • NEW YORK • LONDON • TORONTO

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



6 HANDWHEEL TURNS OPEN OR CLOSE VALVE

This quick closing feature is an important consideration in water pumping operations as illustrated above or any application where a battery of synchronous driven pumps discharges into a common header.

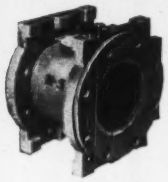
Normal procedure when starting a pump is to shut off the discharge valve until the pump has gained the desired speed. The valve is then opened gradually. Since it requires only a few seconds of an operator's time, this important operation is not likely to be neglected when R-S Valves are installed. Burned-out motors at start-ups can be practically eliminated.

R-S Valves show substantial savings in pumping power due to low pressure drop. Consider also the compact design, light weight and self-cleaning features.

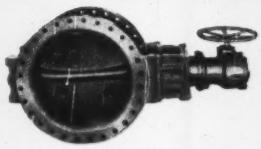
Consult with your local R-S representative. Look for the address and phone number listed under "R-S Products, Valves" or write direct.

R-S PRODUCTS CORPORATION
Wayne Junction • Philadelphia 44, Pa.

Sectional view shows beveled vane of R-S Valve firmly seated at a 12½° angle. A metal-to-metal seat gives satisfactory commercial shut-off in many cases. Manual or automatic control available.



Drip tight or bubble tight closure can be obtained with a rubber seat. Under pressure, due to the 12½° angle of closure, the rubber yields both radially and longitudinally around the shaft-bosses and the periphery of the valve vane to insure positive shut-off.

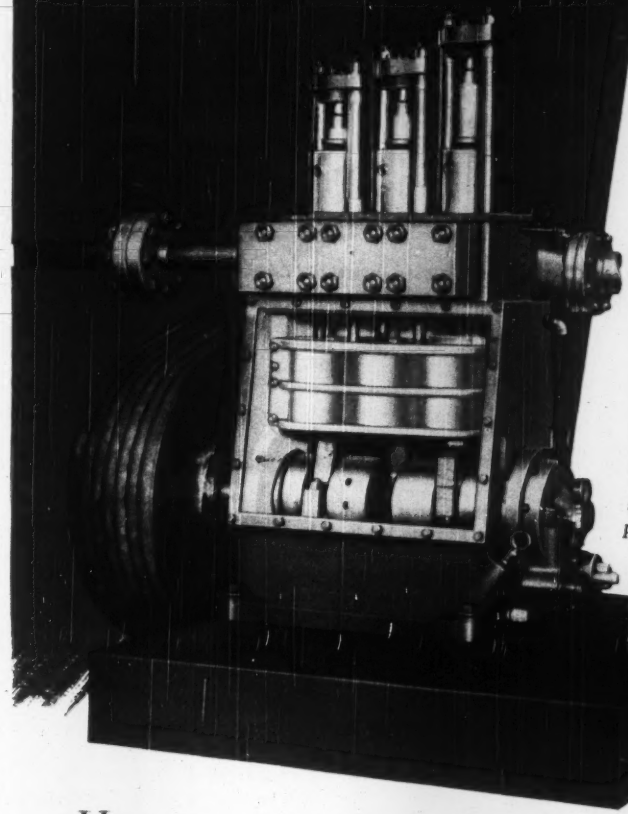


No. 709 30-inch 50-pound valve equipped with rubber seat. Air bubble tight at 80 psig and drip tight with water at 100 psig. Fully enclosed gear reduction drive. Every R-S Valve is available in smaller and larger sizes, in all materials and for lower and higher pressures.

New!

Catalog No. 18 featuring R-S 50-pound valves is just off the press. Ask for it!

Aldrich 5" Stroke Direct Flow Pump Series



The ALDRICH 5" Stroke Direct Flow Pump is *new* in design! *New* in sectionalized replacement elements! *New* in price!

These pumps, built in standard Aldrich series with 3, 5, 7 or 9 cylinders, range from 100 to 275 hp and provide for those pressures normally required in industrial operations.

Look at these *new* design features: a *sectionalized* fluid-end — of distinct advantage in that individual sections can be replaced *at a fraction of the cost of an entire end unit;* close clearances to handle light liquids at high volumetric efficiency; easy access to valve assemblies; a wide choice of plunger sizes — changeable without removing stuffing box liners; and throughout this 5" series all wearing parts other than main bearings are interchangeable.

Here is a pump, at a new low in price, designed for economy, reliability, accessibility and low maintenance. Send for Data Sheet 64 for full details on how a new Aldrich 5" Stroke Direct Flow Pump can assure you *better* service and *improved* economy. Write today:

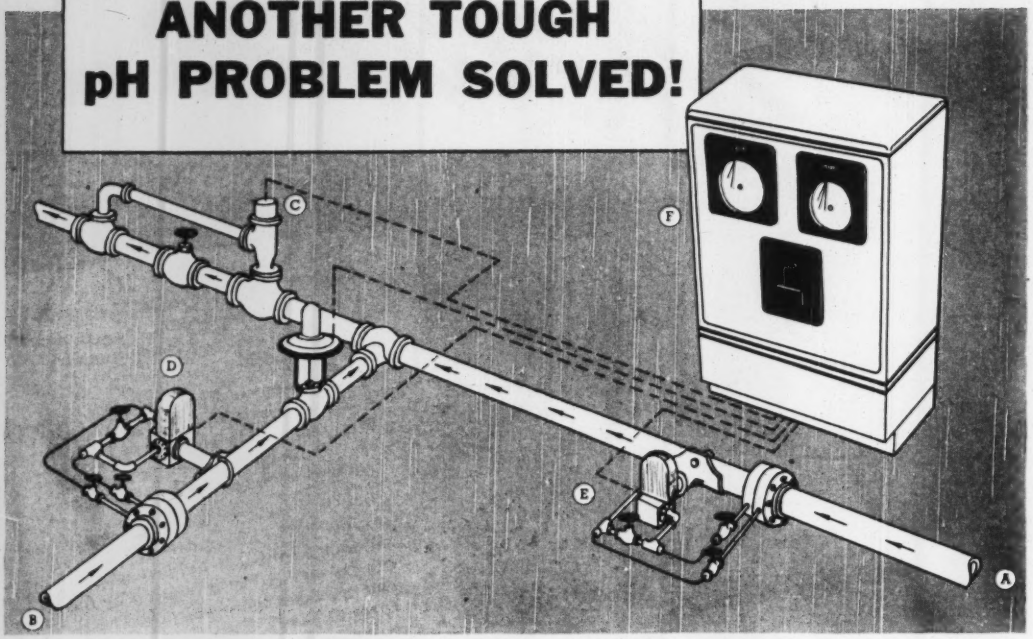
Representatives: Birmingham • Bolivar, N. Y. Boston • Chicago • Cincinnati • Cleveland Denver • Detroit • Duluth • Houston Jacksonville • Los Angeles • New York • Omaha Philadelphia • Pittsburgh • Portland, Ore. Richmond, Va. • St. Louis • San Francisco Seattle • Spokane, Wash. • Syracuse • Tulsa

THE ALDRICH PUMP COMPANY

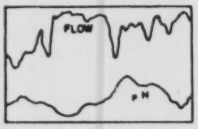
29 PINE STREET, ALLENTOWN, PENNSYLVANIA

All Aldrich Pumps Have **STAYING POWER**

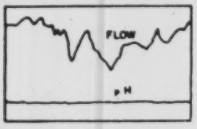
ANOTHER TOUGH pH PROBLEM SOLVED!



. . . by FOXBORO Coordinated Control



THE PROBLEM: To control the pH of fluid (A), a corrosive material varying both in volume and concentration. Flow and unadjusted pH of (A) are shown in curves (left). Since there is no capacity in the system, the high rate of change of flow makes simple pH control inadequate. Adjusting chemical (B) is in a head tank and has constant concentration.



THE SOLUTION: Flow ratio control is employed to maintain the flow of (B) in precise relation to the varying flow of (A). The ratio itself is continuously adjusted by a pH controller. Flow measurements are transmitted to the ratio controller by stainless steel differential pressure cells (D) and (E), while pH is measured at a point (C) where the reaction is complete.

INSTRUMENTATION: *Foxboro d/p Cells* (D) and (E) are mercury-less, highly accurate and corrosion-free. Max. working pressure, 1500 psi. Min. differential range, 0-100".

Flow-Ratio Receiver-Controller, with Pneumaticset — a Model 40 Stabilog*, having proportional and automatic reset control-action.

pH Dynalog* Electronic Controller provides continuous *stepless* balancing. Unmatched sensitivity, response, and accuracy. No slide wires. Range 3-10 pH. Provides Pneumaticset control with proportional reset and derivative (Hyper-Reset) action. pH flowtype electrode assembly for pressures up to 30 psi. Maximum temperature 194°F.

Cabinet (F) is of dustproof construction, rust-proof finish, with removable instrument panel. All instruments completely wired and piped before shipment.

The same facilities and engineering skill that produced the solution above are available to help find the most effective answer to your specific pH control problems. Why not discuss them with your nearby Foxboro engineer? Send for pH Bulletin 430. **The Foxboro Company, 182 Neponset Ave., Foxboro, Mass., U.S.A.**

*Reg. U. S. Pat. Off.

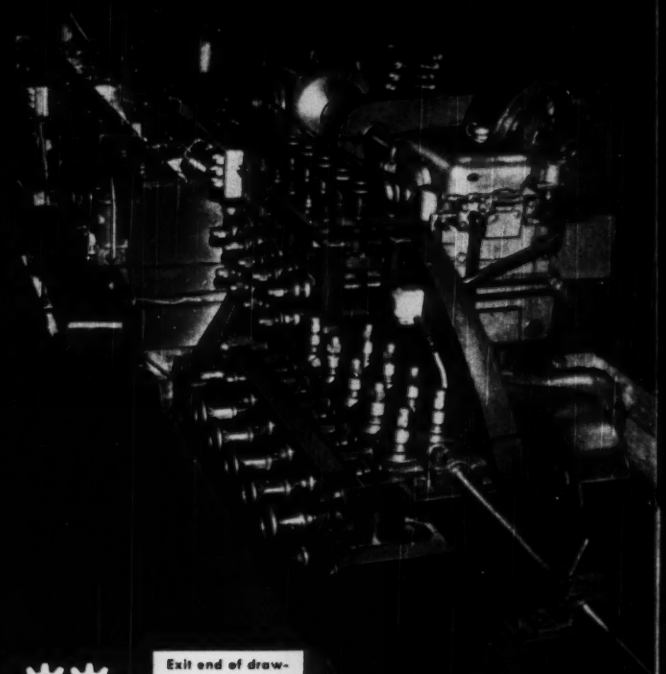
FOXBORO REG. U. S. PAT. OFF. **COORDINATED CONTROL**

Amazing Lomatic Doubles and Triples Past Output

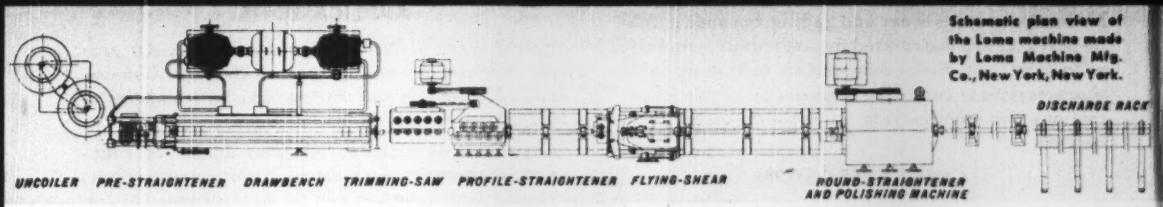
EMPLOYS

OILGEAR

AT CRUCIAL POINTS



Exit end of drawbench showing the twin Oilgear Fluid Power Pumps.



Schematic plan view of the Loma machine made by Loma Machine Mfg. Co., New York, New York.

AN unusual type of rod-processing machine produces finished stock at a rate two to three times faster than on conventional drawbenches or other types of continuous drawbenches.* Drawing, straightening, shearing and polishing of brass rod are done in one operation on these Oilgear-equipped Lomatic machines.

Oilgear variable delivery pumps, cylinders and valves operate feed roll clamp to start rod through the pre-straightener. The Oilgear equipment provides synchronized operation in tandem and high-speed alternate drop-back in the draw carriage cycle. These functions are crucial to the successful operation of the Lomatic. The wonderfully smooth and steady drawing speed gained from Oilgear equipment means the production of uniformly high quality stock. The operator has full manual control of his machine for set-up and test purposes. He has remote pushbutton control of each carriage . . . and full automatic continuous operation. These superiorities result from the Oilgear simplified fluid power and control system.

Here is another outstanding achievement in machine design where Oilgear Fluid Power plays an important role in enabling the designer and builder to gain the requisite flexibility of application and control of power, simplicity of construction, engineering and installation, sturdiness, and built-in protection against overload.

You can do things with *this* power you *CAN'T* do with any other power . . . and you can do them *BETTER* with Oilgear Fluid Power equipment. What is your problem? Write THE OILGEAR COMPANY, 1570 W. Pierce Street, Milwaukee 4, Wisconsin.

*See article "Brass Rods" published in THE IRON AGE, April 14, 1949.

See Sweet's 1950 File for Product Designers, Section 4C/6.

Oilgear

PIONEERS IN FLUID POWER

Pumps, Motors, Transmissions, Cylinders, and Valves

NI-RESIST...
AN ECONOMICAL METAL

for resisting Corrosion, Erosion and Metal-to-Metal Wear

NI-RESIST* is the trade name of a high nickel cast iron – one of the most economical corrosion-resistant engineering materials ever developed.

NI-RESIST, mechanically similar to gray iron, and resembling austenitic stainless steel in many characteristics, provides a unique combination of properties at moderate cost . . .

RESISTS CORROSION

NI-RESIST resists corrosive attacks of *acids, alkalies* and *salts* to a degree unmatched by any other product of the cast iron industry. In strong corrosives it has 20 to 200 times the resistance of plain iron, and 5 to 50 times the resistance in mild environments.

CURBS WEAR

NI-RESIST reduces wear and galling, because graphite particles are distributed throughout its structure, as in gray iron. From this, and its work-hardening characteristics, come the superiority of NI-RESIST castings for components in metal-to-metal wear service.

CHECKS EROSION

This superior wear-resistance . . . together with inherent resistance to corrosion . . . makes NI-RESIST an outstanding material for curbing erosion by liquids and slurries. By long, trouble-free control of erosion, NI-RESIST castings reduce maintenance costs, production tie-ups and the expense of replacements.

WITHSTANDS HEAT

Although primarily used to resist corrosion, erosion and metal-to-metal wear . . . NI-RESIST is also specified for resistance to elevated temperature effects. Castings of NI-RESIST show up to 10 times better scaling resistance, and up to 12 times better growth resistance than those of plain iron at 1300 to 1500°F.

MACHINABILITY and OTHER PROPERTIES

NI-RESIST of normal hardness machines like 200 BHN gray iron and is readily weldable.

NI-RESIST has high specific electrical resistance. Thermal expansion can be controlled, from 60 per cent higher than that of plain iron to a low approximating that of Invar.

NI-RESIST is usually lower in cost than most other corrosion-resistant alloys. It is produced by authorized foundries only, in all industrial centers of the country. NI-RESIST castings have no more limitations in size and complexity than those of any gray iron.

APPLICATIONS

Several types of NI-RESIST *are available. All provide the fundamental properties described above, and differ only in certain special characteristics to meet a variety of industrial demands.*

Applications include: Salt filter drums, oil refinery tube supports and headers, turbine nozzle rings, cylinder liners, valves and fittings, furnace rollers, textile rolls, comminuter parts, blow pit pipes, precision machine tool spindle heads, bridge, and work supports, magnet housings, sugar retorts, etc.

FULL INFORMATION

May we send you two booklets? One, entitled, "Engineering Properties and Applications of NI-RESIST," includes corrosion data on NI-RESIST and cast iron under 400 different corrosive conditions. The other, entitled, "Buyers' Guide for NI-RESIST Castings," lists producers of NI-RESIST castings. Both are yours for the asking. Write for them today.

*Reg. U. S. Pat. Off.

EMBLEM OF INCO SERVICE TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 72 NUMBER 3

Contents for March, 1950

DEVELOPMENTS IN RIVER TRANSPORTATION OF PETROLEUM	*C. R. Horton, Jr.*	205
MECHANIZED JOB-SHOP FOUNDRY FOR ALUMINUM	*C. H. DeLamater*	211
ABSORPTION REFRIGERATION	*A. A. Berestneff*	216
QUALITY-CONTROL INDICATOR	*R. C. Miles*	221
NEW CONCEPTS OF ABRASIVE PROPERTIES AS AFFECTING GRINDING PERFORMANCE	*H. W. Wagner*	225
AVIATION AS AN INSTRUMENT OF PEACE	*H. L. Dryden*	227
THE OBLIGATION OF MANAGEMENT TO PROVIDE LEADERSHIP	*F. S. Blackall, jr.*	229
REGISTRATION BY ENDORSEMENT	*D. B. Steinman*	232

EDITORIAL	203	REVIEWS OF BOOKS	259
BRIEFING THE RECORD	235	ASME BOILER CODE	261
ASME TECHNICAL DIGEST	247	ENGINEERING PROFESSION, NEWS, NOTES	263
CONTENTS OF ASME TRANSACTIONS	251	ASME NEWS	267
COMMENTS ON PAPERS	252	ASME JUNIOR FORUM	272

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC. 276

INDEX TO ADVERTISING PAGES 98

OFFICERS OF THE SOCIETY:

JAMES D. CUNNINGHAM, *President*

J. L. KOPF, *Treasurer* C. E. DAVIES, *Secretary*

PUBLICATIONS STAFF:

GEORGE A. STETSON, *Editor* FREDERICK LASK, *Advertising Mgr.*

K. W. CLENDINNING, *Managing Editor*

PUBLICATIONS COMMITTEE:

R. B. SMITH, *Chairman*

JOHN HAYDOCK G. R. RICH

C. B. CAMPBELL PAUL T. NORTON, JR.

H. G. WENIG, D. R. THOMAS } *Junior Advisory Members*

REGIONAL ADVISORY BOARD OF THE PUBLICATIONS COMMITTEE

KERR ATKINSON—I
OTTO DE LORENZI—II
W. E. REASER—III
F. C. SMITH—IV
HENDLEY BLACKMON—V
R. E. TURNER—VI
R. G. ROSHONG—VII
M. A. DURLAND—VIII

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price 75 cents a copy, $7.00 a year; to members and affiliates, 50 cents a copy, $4.00 a year. Postage outside of the United States of America, $1.50 additional. Changes of address must be received at Society headquarters three weeks before they are to be effective on the mailing list. Please send old as well as new address. . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879 . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921 . . . Copyrighted, 1950, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

MECHANICAL ENGINEERING is indexed by the Engineering Index, Inc.

The U. S. Navy's Rocket and Jet-Powered Research Airplane D-558-2 Skyrocket, in Flight

(Flights of this Douglas-built rocket-jet powered Skyrocket into the supersonic are said to be routine. Reports indicate that the aircraft performs normally when passing through the critical speed of sound range. For details see pages 150 and 151 of the February, 1950, issue of MECHANICAL ENGINEERING.)

VOLUME 72
No. 3

MECHANICAL ENGINEERING

MARCH
1950

GEORGE A. STETSON, *Editor*

Better Meetings

FROM time to time the Council of The American Society of Mechanical Engineers expresses concern over the size of ASME meetings and the quality of papers presented at those meetings. This show of concern is a credit to the Council. It is proof that the Council has not lost contact with or interest in one of the basic objectives of the Society—the holding of meetings for the presentation of papers. It is evidence of a desire for quality, rather than quantity, and for depth as well as breadth of interest in technical developments. It is an indication also that the Council is thinking of the benefits to be derived by members who attend meetings and read ASME publications.

There are many aspects of the size of a meeting to be considered—the length of the program in days, the number of sessions, the registration, the number of papers presented, the number and variety of subjects discussed, social events, committee meetings, plant visits, lectures, dinners, and special events. When the Society was young its membership was small and so were meetings, according to today's standards. All the members in attendance at meetings could assemble in a single room where the President himself presided and technical papers were presented and discussed. A meeting was a table d'hote affair. Each course was planned with care and was well served. Every member could take part in every event; and in the interval between meetings the entire proceedings could be published without excessive expense.

This early type of meeting set certain natural limitations on the number and character of the technical papers presented. The subject matter was of common interest and value and the quality of treatment had to be of a high order of excellence to warrant a place on the program. Discussion was important and lively, and because there were no competing events the members best qualified to take part in the discussion were present to do so. The relatively small size of a meeting was an important factor in the benefits derived from it by each member in attendance.

As the Society grew in membership, as the variety of interests multiplied, as the number of papers pressing for presentation increased, as the committee structure grew, and as technology itself expanded, the simple single-channel character of ASME meeting programs changed. Limitations of meeting space and time forced the practice of simultaneous sessions. An increase in the variety and extent of the subject matter falling within the field of interest of mechanical engineers led to specialization, and specialization resulted in further divisions of Society membership along technological lines. A desire for concentration of effort for the advancement of some of these specialized branches of technology led to the formation of professional divisions and, in some cases, to the formation of new societies in which the singleness of purpose and interest, characteristic of early ASME history, could be exercised in a limited area. But in spite of single-purpose professional-division conferences and the formation of splinter groups, expansion was so rapid in the growing Society that the difficulties born of "bigness" were only temporarily ameliorated.

The activities of professional-division program-making agencies and of committees interested in promoting specialized subjects led to a Society meeting pattern that gave the impression of a combination meeting of a dozen or more independent groups which found it convenient to use a common headquarters and a common meeting date. If a member's interests lay within one or two of these several groups, he might continue to work out his own personal schedule to include the sessions of value to him. But even if his choice of subjects was limited, he frequently found two or more papers scheduled for presentation simultaneously in different rooms. This condition grew until on occasion as many as eight simultaneous technical sessions have been held, exclusive of committee meetings, plant visits, and other nontechnical events. No amount of careful planning on the part of the Meetings Committee could completely avoid conflicts even by extending the meeting to six days and using evening as well as daytime periods. Bigness was demonstrating some of its disadvantages.

Because of such circumstances as those just cited in which a dozen or more programs of independent specialized groups were combined in a single ASME meeting, some critics have asserted that quality has been sacrificed for quantity. Before this criticism is taken too seriously, the objectives of program-making groups must be examined. It must be remembered, for example, that a useful and satisfactory technical session can be built around papers that no one would think of recommending for publication either in MECHANICAL ENGINEERING or Transactions. Originality, thoroughness of treatment, permanence, as reference material, are not the sole criteria where certain types of sessions are concerned, even though they may be of paramount importance in publication. On the other hand, some papers that should be published have little or no value as a basis for discussion from the floor.

Nor can it be admitted that all papers should be judged by the same measuring stick. Some fields of technology

are more highly developed and have a more extensive literature than others. Some are closely related to the sciences; others fall more properly in the field of the mechanic arts. Some papers report the results of original researches; some are fundamentally analytical; some deal with the natural physical sciences, others with the social sciences. Some papers are intended for engineers whose primary interests lie in theory and design; others for those who are concerned with practice and operation. Such classifications are numerous and varied. Criteria of quality for one classification may not apply in another. What is important is that in each classification quality shall be of the highest order.

Regardless of what classification a paper may fall into or the objectives a program-making group may have in mind when it sets up a program, there are certain practices that are more likely to result in papers of high quality than others. A group which sets and insists on high standards, and maintains them by thorough and painstaking review procedures, will eventually attract the best papers and is not likely to lack for material. Planned programs in which an attempt is made to cover several phases of a single subject are sometimes disappointing. In making up such programs it is usually necessary to solicit some papers. Although many solicited papers turn out to be of high and even superior quality, others prove to be mediocre potboilers or otherwise fail to meet the desired specifications. Unless the solicited paper of inferior quality is discovered in time to ask the author to revise it or in time to find a substitute of better quality, an otherwise excellent program may be seriously diluted in quality.

There is no easy way to insure high quality in ASME papers or fewer sessions and papers at ASME meetings. To effect improvement in either or both requires a lot of hard, time-consuming, intelligent, and conscientious effort on the part of earnest and unselfish men who are willing to devote their talents to the task for the benefit of fellow engineers. These men must establish and maintain high standards and clearly defined objectives. They require a profound knowledge of the fields they serve and of the men engaged in those fields, vision to comprehend needs, sound and critical judgment, freedom from bias, and courage to insist that authors meet their specifications. Hundreds of such men serve or have served on ASME program-making groups. Hundreds more exist and would serve if offered the opportunity. The problem is to discover these men and put them to work so that a steady flow of superior talent shall be available to strengthen and enrich the contributions of ASME to the technology of its field. If quality can be assured, the problem of quantity can be easily handled.

No Substitute for Freedom

FREEDOM knows no substitute. Security, health, comfort, education, wealth, and public honors will not satisfy men who have lost their freedom. All these and life itself will be sacrificed by men to regain lost freedom.

America today needs a rebirth of freedom. It needs men who will impose the responsibilities and disciplines of free citizenship on themselves. For years the ASME Engineers Civic Responsibility Committee has been urging engineers to be better citizens in the cause of freedom. It has asked a number of engineering and industrial leaders to state their views on this subject. The statement of William T. Faricy, president, American Association of Railways, follows:

"The world in which we live is physically shaped by the technological thinking in which the engineer is trained. But the uses to which this developing technology is put are largely determined by political thinking. If technological training and thinking are to produce the best results, the political thinking and action which determine the nature and scope of opportunity must be sound.

"In all human history, no period has seen such progress in invention and technology as have the past two centuries. It is no accident that this progress has come in the time, and in the places, where men have enjoyed wider freedom of thought and action than ever before. Part of the work of the engineer, then, is to help preserve the conditions of freedom and opportunity which make it possible for him to do his work in the world to the best advantage.

"Experience has shown beyond all doubt that the profit-and-loss system of individual incentive is the most effective means to that end. Conceding the imperfections in the actual working of the system, let us consider the prospective working of the scheme suggested to supplant the profit-and-loss system. This scheme is attractively labeled "production for use and not for profit." But someone must determine what is to be produced, by whom, for whose use, and on what terms. In the profit-and-loss system, the final determinant of what is to be produced and by whom it is to be used is the will of the consumer, expressed in the market place. He—millions of him—determines these matters by his daily choice of the goods and services he uses and the prices he is willing to pay.

"It might be that this determination could be taken over by some omniscient and omnipotent board, or commission—or commissar. The whole assumption underlying the theory of production for use and not for profit is that there would be such an all-wise and all-powerful governing body, with perfect grasp of all the myriad factors involved, and with perfect disinterestedness.

"But certainly there is no warrant for any such belief in what we know of either the nature of man or his history. If we would preserve the freedom of thought and action which has been the background of the tremendous technological accomplishments of the past two centuries, there is no substitute for freedom of choice.

"It follows, therefore, that to be an engineer is not by itself enough. The engineer must also be a citizen, one who takes his part in the processes of political thought and action, as well as in technical thinking and development. And he must be such a citizen as, despite the encroaching forces of the collectivist state, will take his stand for the freedom of the individual."

Developments in
RIVER TRANSPORTATION OF PETROLEUM

By C. R. HORTON, JR.

NAVAL ARCHITECT, DRAVO CORPORATION, NEVILLE ISLAND, PITTSBURGH, PA.

THE postwar period has seen the application of many important engineering developments in transportation of petroleum products on our inland waterways. In fact, the oil industry for many years has been the leader in the application of new ideas to river transportation. The great expansion of petroleum tonnage on the rivers, starting before the last war and accelerated greatly during the tanker emergency period, was a contributing factor to this leadership. However, a large part must be credited to the unusual disrespect for tradition in the oil industry in its competitive search for lower costs.

The situation in this country today where we find the oil companies providing highly significant developments in the construction of seagoing vessels and inland-waterway equipment simultaneously is not just accident growing out of unique demand for expansion of facilities. Marine equipment has developed through slow evolution, due perhaps to the complexity of the problems. The oil industry, in which overnight obsolescence is common, is no worshiper of past methods. Its engineers have aided greatly the introduction of new techniques into the river-transportation field.

The main problem of the oil industry in using waterways seems to be in evaluating the lower costs that can be obtained and the resultant place of such transportation in the over-all rather complex picture. Inland waterways, particularly the Gulf Intracoastal Canal and the Mississippi-Ohio River system (Fig. 1), now occupy a major position in their area in the handling of both crude and refined products. Water competes here with pipe lines, tankers, rail, and truck methods. Water transportation has survived and grown in the midst of this competition because it has something to offer. That something has increased in the past few war and postwar years, to the extent of a general downward trend in costs, while competing forms of transportation have been experiencing increased costs. This has been due largely to the application of new methods to barge, towboat, and terminal operations, with resultant increased efficiency of equipment.

BARGE DEVELOPMENTS

The barge-design field has seen the most spectacular of recent developments. The war period was characterized by a forced growth in the movement of both crude and finished products out of the Texas-Gulf areas to the South Atlantic Coast and areas along the Mississippi-Ohio river system. The equipment used and built for this emergency was, in general, low in efficiency, compared with existing knowledge, but the trade continued at a high volume after the war. The mid-continent oil-field production declined considerably, and refineries in this area had to go south for their oil. The chemical industry in the Gulf area had large quantities of bulk chemicals to ship to its northern markets. This situation led to the construction of numbers of liquid-carrying barges in the postwar period, and most of these have taken advantage of the newer ideas in barge and fleet design.

The most publicized development which has been fairly generally adopted is the integration of barges into fleets without the usual formed ends at the connections. The leading barge of a two-barge tow is shown in Fig. 2. While not a new idea, its use carried with it a multitude of operational problems which had to be worked out on the river. The effect of integration varies considerably with the size and complexity of the fleet, but, in general, it reduces resistance about 25 per cent and increases cargo capacity, all without increasing the cost of the barges themselves. A typical comparison is shown in Fig. 3.

The operational problems which still remain are largely

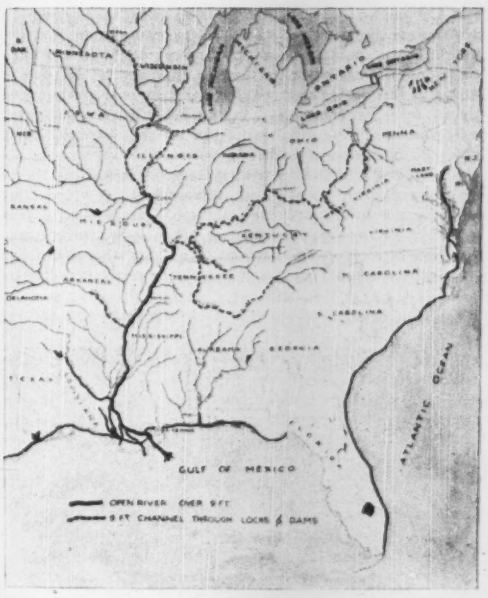


FIG. 1 OPEN RIVER AND CANALIZED NAVIGABLE PORTIONS OF THE MISSISSIPPI RIVER SYSTEM

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, Oklahoma City, Okla., October 2–5, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

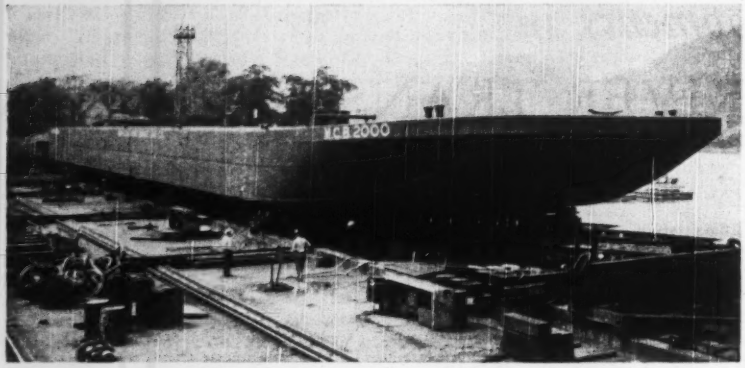


FIG. 2 LEADING UNIT OF A TWO-BARGE TOW FOR HIGH-SPEED MOVEMENT OF PETROLEUM BARGES

related to flexibility of operation, since the square ends are not low in resistance when exposed by the loss of a mating barge, due either to damage, dropping of a single barge at an intermediate terminal, or the necessity of reducing the fleet for maneuverability or extreme current conditions.

Study of the economics of integration in several oil-carrier fleets has substantiated the fact that this feature alone can reduce costs by as much as 25 per cent and the author's company has recently completed model testing on this problem which indicates that the use of semi-integrated barges can be greatly expanded to operations not now considered, even to the common carrier fleets, Fig. 4.

The semi-integrated fleet consists of barges with one square end and one shaped end, operating as pairs, and arranged in any desired combination. This system, or a variant of it with middle box units, has been adopted by one of the largest operators for upstream crude movements from several different terminals. The performance of this type tow is somewhat lower than a fully integrated unit, but its flexibility has substantial values in use. Operators can break up the tow into smaller units during high-water periods to pass local bad spots and are able to drop off or pick up pairs of barges. A tow can thereby be designed closer to its most efficient speed, a speed which leaves only a small margin over occasional currents encountered.

Except for the very unusual case where lock restrictions are not encountered, barge damage is almost nonexistent, and terminal-to-terminal operation is used, the semi-integrated tow

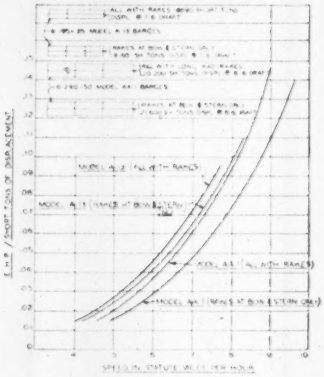


FIG. 3 EFFECTIVE HORSEPOWER CURVES FOR FLEET OF SIX STANDARD BARGES VERSUS FLEET OF SIX INTEGRATED BARGES
(Depth of water, 12 ft.)

seems to offer most in the way of service at low cost. In smaller tow sizes, predicated on tonnage available and terminal facilities, the fully integrated tow is undoubtedly advisable, but

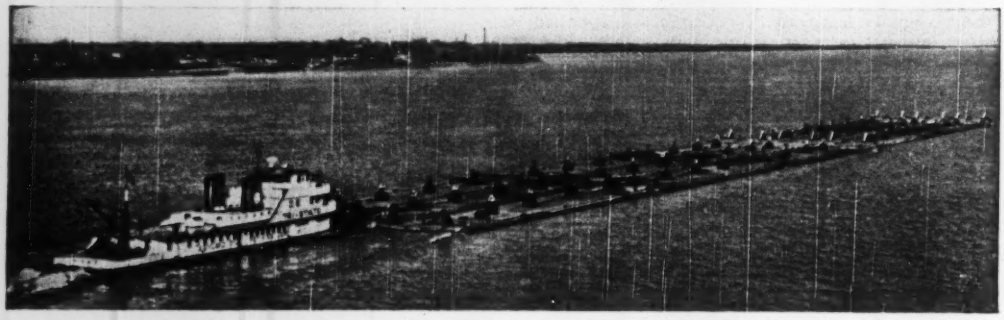


FIG. 4 SEMI-INTEGRATED, 15-BARGE TOW MEASURING OVER 1100 FEET IN LENGTH

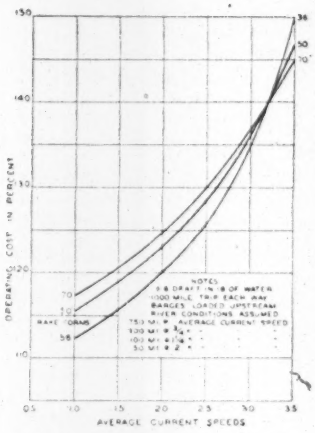


FIG. 5 PER CENT COST VERSUS CURRENT SPEED FOR 1400-HP SINGLE-SCREW TOWBOAT WITH 7-FT-DIAM PROPELLER IN KORT NOZZLE AND TWO 240-FT × 50-FT INTEGRATED BARGES

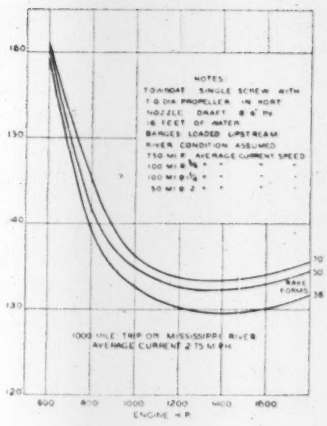


FIG. 6 PER CENT COST VERSUS TOWBOAT HORSEPOWER FOR TWO 240-FT × 50-FT INTEGRATED BARGES WITH VARYING RAKE FORMS

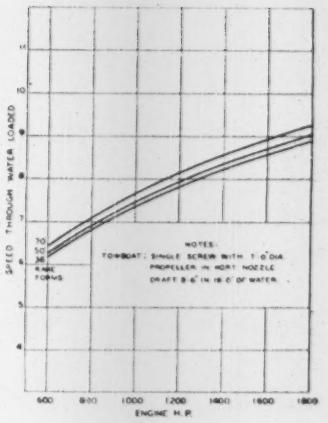


FIG. 7 SPEED VERSUS TOWBOAT HORSEPOWER FOR TWO 240-FT × 50-FT INTEGRATED BARGES WITH VARYING RAKE FORMS

these smaller tows do not compete in cost with the large units.

The small-capacity two- or three-barge tow of 30,000 to 60,000 bbl has been generally integrated, and is used effectively in combined canal and river operation or where lock size restrictions are small, as in the Tennessee and Cumberland Rivers. The development of integration can be said to have made it possible for the small-capacity tow to remain useful. The value of size of unit alone must not, however, be overlooked, since the largest semi-integrated oil tow now operating, carrying 22,000 tons or 155,000 bbl of crude in fifteen 195-ft × 35-ft barges can do so at costs per ton-mile roughly two thirds of the typical 30,000- or 40,000-bbl tow of two 240-ft × 50-ft or 290-ft × 50-ft barges.

Another approach to the integration problem is the construction of a hull with the power unit integrated with the barges. This has been done with the motor vessel *Harry Truman* of the Federal Barge Lines and other vessels of Cargill, Inc. This method offers the ultimate in low resistance per ton but in turn introduces still further operating difficulties. It would appear to be a logical end to the progress now being made for certain through trades, with very low costs being possible.

The subject of barge form in the rake ends has received much attention. There is a tendency to feel that there is some one ideal rake form, but this actually is far from the case. In fact, the rake that produces the lowest resistance per ton displacement is not necessarily the best if it involves a loss in total displacement for barges whose over-all size is restricted. Both of these are usually the case. The author's company has prepared a series of curves which illustrates the complexity of settling just the length of a rake, let alone its total form (Figs. 5, 6, 7). Some progress has been made in the direction of producing low-resistance forms that can be economically constructed (for example, Fig. 2), but the progress here, while important, is relatively small compared with the gains due to integration and to choice of barge size.

The thinking concerning barge size has undergone a considerable overhauling in recent years. The old standard river barge was 175 ft × 26 ft, and designed with a form suitable for operation at about 6 to 7 mph at 7 ft 6 in. draft. Later construction produced the 195-ft × 35-ft barge, designed for approximately the same speeds and draft. Construction more recently has concentrated on the latter size, designed for up to 9 ft draft and for speeds up to 12 mph, and on the 240-ft × 50-ft and 290-ft × 50-ft sizes with similar characteristics. Improved river conditions and increased power of towboats have brought about these changes, and with them lower costs per ton of capacity and greater capacity per barge, together with less resistance at economic speeds. The larger barge sizes are particularly suitable for use with fully integrated fleets that cannot be readily broken up, yet the 195-ft × 35-ft size offers greater flexibility at somewhat higher cost per ton or barrel. The large barges introduce some structural problems which are now being recognized and met by special rules for tank barges by the American Bureau of Shipping.

TOWBOATS FOR THE INLAND WATERWAYS

The essential principle underlying the push-towing system used on our inland waterways is that the cargo-carrying barges and the towboat, or propulsion unit, are integrated and operate as a single ship. This method allows the precise control necessary for navigation of crooked rivers with high currents and restricted locks. With this control we can handle large tonnages with lower power, at the same time securing advantages in resistance and propulsive efficiency. Therefore a river towboat cannot be considered an independent vessel, but only as a part of its accompanying barges. To do otherwise is comparable to asking a designer of a seagoing tanker to lay out a power plant and rudder-propeller system without knowing the propulsion requirements and size of the vessel into which it is to be built. The result can be and often is disastrous.

The postwar expansion of petroleum towing has of course required a large increase in number and power of towboats. With notable exceptions, these new towboats have not taken advantage of current knowledge in the fields of propulsion and control, although many improvements in the power-generating function have been generally used. There seems to be an inclination in the river towboat field to look first at cost and second at efficiency, despite the fact that any sound economic analysis will show the value of even large expenditures for improved efficiency.

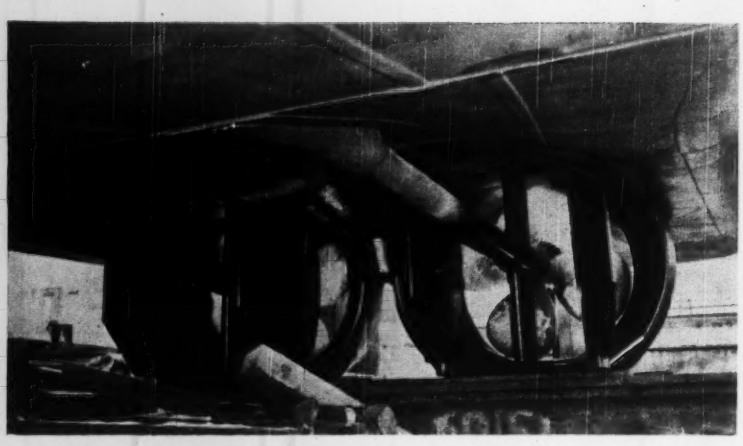


FIG. 8 KORT NOZZLES, COMBINED WITH RUDDERS OF THE PROPER SIZE, SHAPE, AND LOCATION, GIVE MAXIMUM MANEUVERABILITY

FIG. 9 TYPICAL KORT NOZZLE AND RUDDER INSTALLATION ON TWIN-SCREW RIVER TOWBOAT

A river towboat has many functions, such as hotel (and nowadays usually a good one), power station, liquid storage tank, water-purification plant, grocery store, restaurant, lubricating-oil refinery, yacht for owners and guests, etc., all these in addition to its propulsive function. It may be this complexity which masks the overriding importance of the design of the propellers, rudders, attachments, and accompanying hull form.

An aspect of towboat design that has received too little attention is maneuverability. The author's company has analyzed operations of various types using boats which varied considerably in steering and flanking power. The effect of poor steering ability is surprising, causing as much as a 25 per cent loss in towboat performance. When it is realized that we steer a 25,000-ton tow, longer than the *Queen Mary*, with two rudders of less than 150 sq ft total area, around bends with a radius of 2 or 3 tow lengths in currents equal to the boat's speed, the maximum steering forces obtainable are not enough to give any peace of mind. Various complex schemes for greater steering power, such as the Voith-Schneider and Kirsten propellers, or auxiliary units of the outboard-motor type, have been suggested or tried. They have not received general acceptance because of their expense or their unreliability and likelihood of damage. Any system which cannot continue to work all the time is worse than no system, particularly with barges of liquid dynamite out ahead and bridge piers or locks always just downstream. The modern Kort nozzle propeller boat using two or more screws and independent three-rudders per propeller steering offers the simplest and most effective steering and propulsive method so far available. Two typical large installations are shown in Figs. 8 and 9.

The great loss in over-all performance due to poor steering probably stems from a number of causes. Excessive backing or flanking around bends, loss in push with overuse of large rudder angles, and need for extra caution in approaching obstacles constitute the principal factors. More important than this loss under comparable conditions is the necessity of operating with tows too small for the power of the boat. By this is meant speeds in excess of the economical speed, and shorter and wider tows to permit steering. These things can make enormous differences in output with a given power. To secure good maneuverability with high efficiency is one of the most expensive improvements that have been made. One must set standards requiring heavy reliable steering mechanisms, carefully formed hulls, and streamlined rudders and struts, all combined with the Kort nozzle. The extra dollars, however, pay larger dividends than any other aspect of towboat design.

Mention has been made of the importance of considering the towboat and its barges as a unit. An example of this is shown in Fig. 10 which demonstrates the effect on cost of varying speed through the water (or, in actuality, towboat power versus fleet size), with varying current conditions. This chart also was prepared for a typical petroleum-towing problem. While not widely applicable in detail, the trends indicated apply to all river operations.

ADVANCES IN PROPELLING MACHINERY

The marine-engineering phases of towboat design have made

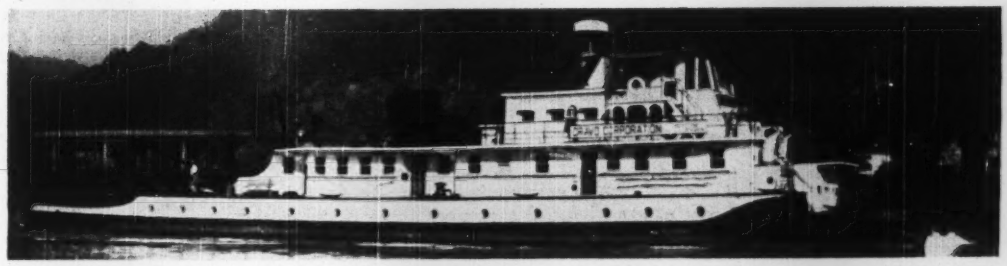


FIG. 11 DIESEL-POWERED, TWIN-SCREW TOWBOAT KEYSTONE
(The vessel is 145 ft long and is equipped with Kort nozzles.)

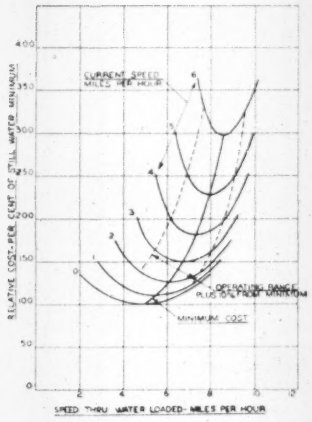

CURRENT SPEED MILES PER HOUR
RELATIVE COST PER CENT OF STILL WATER MINIMUM
MINIMUM COST
SMED THOU WATER LOADED MILES PER HOUR

FIG. 10 EFFECT OF CURRENT VELOCITY ON TOWING COST

considerable progress in recent years. For many reasons the Diesel engine had already taken over the river towboat field before the recent expansion. The newer Diesel vessels differ from earlier ones in many respects, however. Basically, the petroleum and chemical movements have greatly increased the upstream tonnage without accompanying downstream cargo, so the power of towboats has been increased. Ten years ago a 2000-hp towboat was a rarity. Now 3000-hp boats are fairly common, with a few vessels over this size.

Two types of Diesel power plants are coming to the forefront, namely, the higher-speed two-cycle blower supercharged and four-cycle Büchi supercharged engines. The increased speed of these units has forced the general adoption of reduction-gear drives, permitting the use of larger-diameter propellers suitable to the power and available draft, whereas the older direct-connected engines usually forced a compromise between engine and propeller detrimental to efficiency. The high-speed and war-encouraged modern engineering of these Diesels has led to a great reduction in weight for a given power, even including the gearing, thus allowing the construction of smaller less expensive boats with improved efficiency. The two boats illustrated here are typical of old and new developments for the same job (Figs. 11 and 12). The smaller and newer *Wm. Pitt*, Fig. 12, using supercharged two-cycle engines, develops about the same 800 engine horsepower in service as the older Keystone, Fig. 11. The vessels have identical beams but the newer vessel is 116 ft in length against 145 ft for the other. The *Wm. Pitt* has larger propellers at slower speed and delivers about 15 per cent more push power with better maneuverability. Both vessels use Kort nozzles and other efficiency features, and are functionally comparable.

The great increase in labor costs that has occurred has fostered the development of new control systems to allow the pilot to handle the engines directly, thus freeing the engineers for maintenance work, with a resultant reduction in engine-room personnel. These control systems utilize mechanical, electrical, and air systems, and have been very successful. The better control afforded pilots has brought about more output and fewer accidents. The Diesel-engine and reduction-gear manufacturers have co-operated closely with the control manufacturers. All three, together, have produced new devices to provide the necessary reliability, speed, and ease of control.

The simplification possible in a Diesel engine by eliminating reversing has always been attractive. This has been accomplished by the development of new reverse-gear units using mechanical, air-actuated, and eddy-current clutches, in the large sizes necessary for the larger powers being used. These, combined with the control features and reduction gears, have produced propulsion units that are reliable, moderate in cost, and allow use of the most efficient propellers within the draft limitations. These developments have also inspired a desire for still further progress leading to true "packaged power plants" with very little in-service maintenance. Thus far the Diesel manufacturers have yet to prove such units except in small sizes. The attendant labor savings and reduced time out of service naturally will be most atttactive. Such units are in use in the railroad locomotive field, but the required periods between shutdowns are much longer in marine service.

It has been implied that the reduction-geared Diesel drive has command of the river towboat field. The question of electric drive is always present, and some factors bearing on this equipment have been considerably altered recently. The introduction of the air or eddy-current clutch and pilot-house control gives a control of the power unit that, while not equal to electric drive in very slow-speed inching, nevertheless provides adequate control for the purpose. The Kort-nozzle-equipped propeller, an essential for high-efficiency operation, has about one half the torque change of the open propeller between various towing speeds. The clutched reverse gear drives allow continuous-running one-way engines. These three factors have been the main arguments for electric drive, to offset its higher cost and lower efficiency. Electric drives may well return to the river field on introduction of gas turbines or other high-speed prime movers, but for the moment they cannot pay their way.

The auxiliary equipment of towboats has changed less than the main power plant. Various new devices have been introduced such as deck winches for handling wire connections, skin

coolers, oil-purifying equipment, distillation plants for drinking water, deep-freeze food lockers, and improved efficiency of electric plants by the use of alternating current. However, the major changes that contribute to lower operating costs or greater output have been applied to navigation, with almost complete adoption of 3-cm radar units, and radio telephone. Less generally used are fathometers and automatic steering devices. The elimination of delays due to fog, the improved navigation at night, and very real value of direct communication between boat and home office have greatly reduced costs while improving the reliability of river transportation. The use of gadgets, as such, on marine equipment is usually unsound owing to the maintenance problems involved, but those mentioned have proved themselves because the maintenance problem has been recognized and has been handled intelligently.

TERMINALS AND PUMPING

The process of loading and unloading petroleum products for shipment by river has been altered only slightly in detail, although the investment in terminal equipment has greatly increased. The advantages in handling large fleets have caused expansion of tankage ashore to allow rapid loading and unloading. Most oil-moving operations are of such distance that it is not economical to provide exchange of fleets to give, in effect, floating storage, but this possibility is often overlooked in following tradition where it would effect economies. The larger terminals require increased pumping rates, and this has been accomplished in numerous ways.

A fundamental in designing pumping systems is the location of the pump, either on the barges or on shore at the terminal. The recent trend is not clear on this point, with both systems being used. The gradual standardization of oil trades, and the improvement in terminals, as traffic to one point grows, should lead to placing barge pumps at terminals, on floating-wharf barges. This will reduce the investment and eliminate costly and intermittent maintenance of pumps on barges. However, many trades do not have sufficient volume to warrant elaborate terminals, and barge pumps must be used. Another factor to be considered is the added depth now common in barges, owing to the increased drafts generally available. This leads to increased suction lifts for terminal pumps, whereas barge-mounted pumps of the vertical rotary, centrifugal, or mixed-flow types with below-deck piping, can operate on any barge depth. An oil barge carrying volatile gasolines or solvents with 15-ft suction lifts and 130-deg deck temperature sometimes cannot be stripped. This problem alone may require barge-mounted pumps.

The newer vertical mixed-flow barge pumps driven by deck-mounted engines seem to offer many advantages over the usual deck-mounted rotary units. The former pumps are more economical to buy and to maintain, and they are much smoother running. They offer greater flexibility in capacity with varying discharge heads. By various more or less complex piping arrangements they can be made to strip barges successfully. The trend seems in this direction, for refined-products barges, with the rotary pumps handling the heavier and more viscous materials.

Details of piping and safety devices have not changed greatly, and, in general, follow the lead of the American Petroleum Institute in safety practices developed ashore. Accidents to oil barges on the river are not frequent and rarely cause explosion or fire. The skill of the rivermen and the care in operation fostered by refinery experience have produced safe practices on the river. The chemical industry has lately been introducing new problems, however, and much progress still remains to be made in codification of safe practices for the unfamiliar products of the chemical plants. The U. S. Coast Guard is approaching this problem realistically, and the example set by the "Tanker Rules" is serving well.

CONCLUSION

The engineering of river-transportation equipment still has a long way to go. We spend great effort in solving our peculiar problems, and appreciable progress has been made in the field of knowledge. The study and care usually employed in planning by railroads or seagoing water-transportation systems are often oversimplified on the river, usually because the problems are considered too complex for exact analysis. The use of model-basin testing constantly checked by full-size tests, together with detailed analysis of actual operations over long periods of time, removes much of the guesswork from planning. This technique, constantly refined, is gradually altering equipment and operations. One result of this method is the realization of the inadequacy of the traditional "intuitive" approach. The thumb is gradually giving way to the pencil, with results that enable river transportation to offer more service with lower costs than ever before.

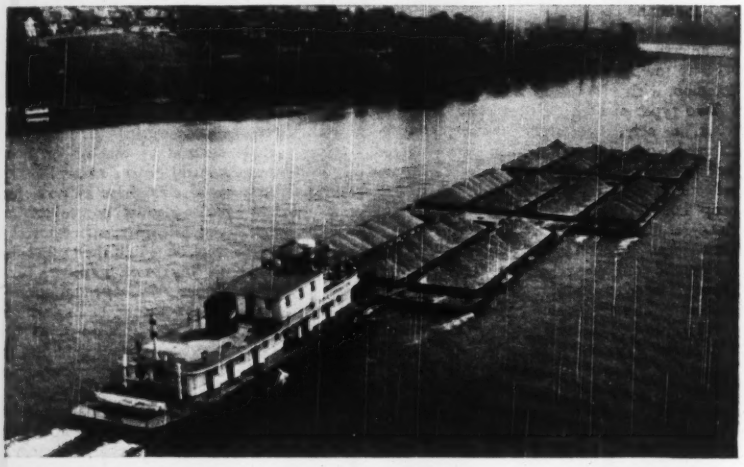


FIG. 12 TWIN-SCREW, KORT-FITTED, DIESEL TOWBOAT, "WM. PITT," TOWING 6600 TONS OF SAND AND GRAVEL IN ELEVEN BARGES

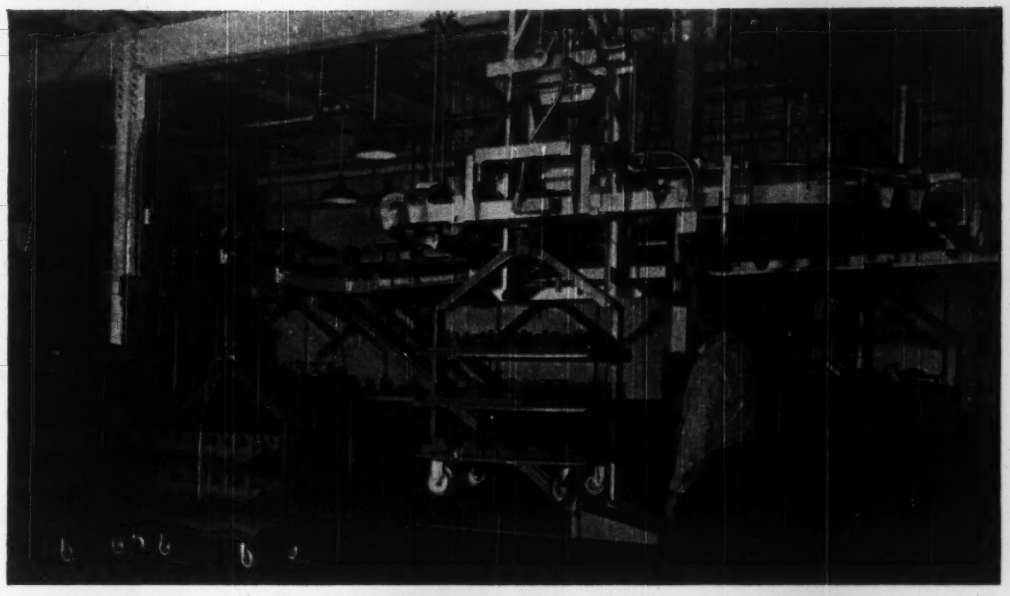


FIG. 1 RAISING A CORE CARRIER TO CONVEYOR SYSTEM FOR TRANSFER TO SAND- OR PERMANENT-MOLD FOUNDRY

Mechanized JOB-SHOP FOUNDRY *for* ALUMINUM

By C. H. DeLAMATER

WORKS MANAGER, ALUMINUM COMPANY OF AMERICA, BRIDGEPORT, CONN.

THE modernized foundry of the author's company at Bridgeport, Conn., has incorporated efficient materials handling along with flexibility in its large-scale jobbing-type operations. This foundry regularly handles 200 to 300 pattern changes monthly—occasionally as many as 1000—and is designed to produce both sand- and permanent-mold aluminum-alloy castings that range from a few ounces to several hundred pounds.

CONVEYOR SYSTEM

The most interesting mechanical feature of the plant is its conveyor system which efficiently handles the flow of materials between the different departments which are located in four main buildings having nearly 380,000 sq ft of floor space. Considering materials handling as a whole, the plant actually employs several different conveyor systems. These include mold conveyor trains in the sand foundry; an overhead monorail system for handling molten metal; overhead and underground belt conveyors for transporting molding sand; and an elaborate power-and-free conveyor system for moving cores, castings, and scrap.

This last-named system, which is unique in application to the foundry industry, has a total length of more than $2^1/_8$ miles. It is particularly well adapted to a plant of this type where materials must be transferred to different floors of the buildings and where one department feeds into two other departments, or vice versa. For instance, the coreroom serves both the sand- and permanent-mold foundries, and both foundries move castings into the trim department. The main power and free conveyor extends from the melting department through the sand foundry, chipping, trim department, coreroom, and permanent-mold foundry. Although not actually one continuous line, but seven independent units, the ability of carriers to switch from one line to another makes it essentially a complete unit.

Three different types of conveyor carriers are employed. For transporting cores, Fig. 1, a rack-type carrier equipped with wheels is used. Rough castings are handled in the box-type carrier shown in Fig. 2. Hopper carriers, Fig. 3, are used to

Contributed by the Materials Handling Division and presented at the Annual Meeting, New York, N. Y., November 27–December 2, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

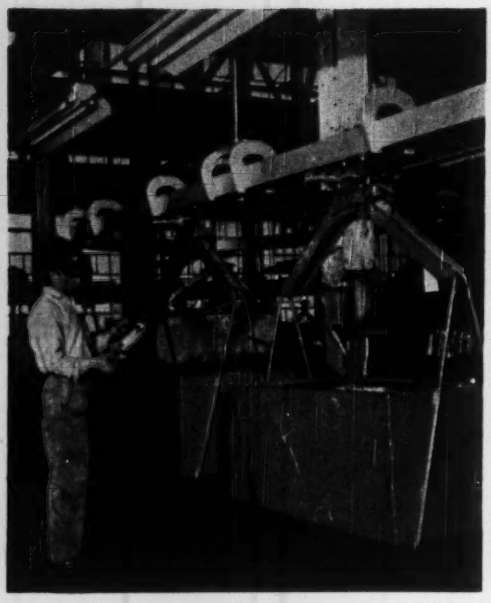


FIG. 2 CASTING STATION IS SERVED BY INDIVIDUAL FREE LOOP TO WHICH OPERATOR CAN DIRECT CARRIERS AS NEEDED

transport return scrap from the rough-trim department to the melting room, and are equipped with drop bottoms for easy unloading.

OPERATION OF SYSTEM

Operation of the system can best be described by following the progress of a single casting produced in the permanent-mold department. Each of the loops shown in the power and free-conveyor diagram, Fig. 4, serves a casting station; all are independent units. Each can accept or reject any given carrier on the power section or can shut down entirely, without affecting the operation of the system as a whole. Carriers are moved along the main conveyor by a power-driven chain. By throwing a control switch, the operator establishes an electric circuit which will cause the next empty carrier on the main line to be switched to this loop.

Once on the loop track, the carrier travels by gravity past a limit switch to a preset mechanical stop on the track. When the next empty carrier approaches, it, too, is switched to the loop. However, its travel is stopped by the first carrier before it trips the limit switch. As a result, no further carriers will be switched to this loop until the operator releases the stop and lets the first carrier proceed to the working area. At that time the second carrier moves up to the stop, tripping the limit switch in the process, and re-establishing the circuit that will permit another empty to enter the loop.

The effect of this arrangement is almost always to have at least one carrier waiting for the operator, and yet to prevent unwanted carriers from piling up at any operation. If the volume of work being performed at a given station warrants, of course it is possible to move the stop so that more than two carriers can enter the siding.

When the operator has loaded the carrier with castings, it is returned to the main powered section of the conveyor through

FIG. 3 TURNTABLE REVERSES SCRAP CARRIER PRIOR TO ENTERING TRIM SCRAP CONVEYOR

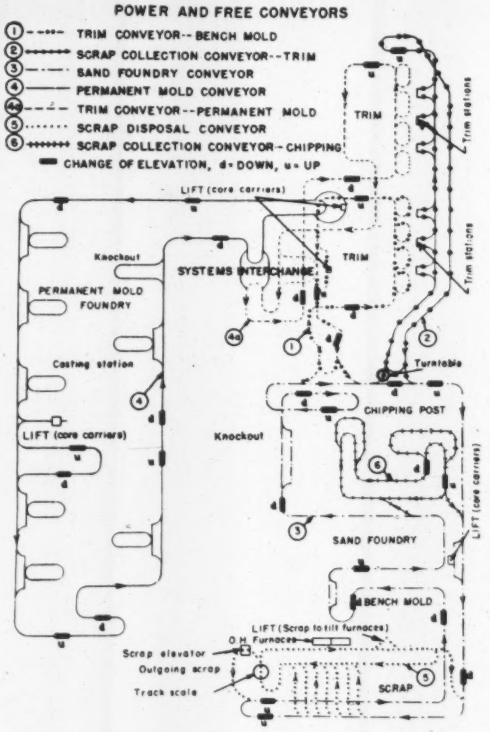


FIG. 4 INTEGRATION OF CONVEYORS PROVIDES AUTOMATIC TRAVEL BETWEEN ANY TWO POINTS IN FOUNDRY
(Carriers are accepted or rejected automatically.)

another system of interlocks. The carrier moves by gravity to a stop a few feet short of the main track, and there waits for the approach of the next empty dog on the chain. (If there is a carrier on the approaching dog, the loop switch cannot operate.) As the empty dog approaches a switching station, it closes a circuit which opens the switch from the loop onto the main track and also activates a pneumatic ram which pushes the carrier forward from the stop. Similar rams are installed at all switching points to insure that static friction does not prevent the carrier from rolling to the main track, where it is engaged by the dog.

Full carriers from the permanent-mold casting stations are sent to permanent-mold knockout and then to trim, or directly to trim. This selection is made automatically by the operator by positioning a selection switch to either knockout or trim which electrically contacts a tab mounted on the main conveyor pusher dog. In this way the full carriers are placed on certain dogs whose tab electrically directs them either to knockout or trim.

As this full carrier proceeds along the main line, it is prevented by the action of a weight-operated microswitch from being switched onto other loops. It travels along the main track to the point where the permanent-mold conveyor connects with the conveyor that goes to the trim room.

At this junction, the setting of the controls is reversed, and full carriers are transferred to the trim line. Any empties that were refused by all loops stay on the permanent-mold track and repeat the trip around the department until accepted by one of the loops.

Switches on the trim line (which also connects with the foundry line, to accept full carriers from that department) are so set that once a full carrier is on the line, it cannot escape except to one of the loops at the trim stations. Trim operators watch carriers as they approach the station and throw the switch for their loop when they see a carrier containing the particular type of casting they are set up to handle. If the loop is full at the moment, the carrier can be permitted to pass and is picked up at the next time around.

FIG. 6 SCRAP COLLECTION AT TRIM INSURES SEGREGATION OF MATERIAL BY HAVING EMPTY CARRIER ALWAYS WAITING

Empty carriers dispatched from the loops at the trim stations are automatically switched back to the foundry or permanent-mold lines.

The trimmed castings are put in baskets and placed on tray carriers, Fig. 5, of the tote-pan chain conveyor which services the finish trim, inspection, and shipping departments. The transfer feature is not required here because the use of removable tote baskets provides the same desirable feature of utilizing the conveyor for transportation only, all operations being performed while the work is stationary.

TRANSPORTING SCRAP

The drop-bottom scrap carriers travel in most cases over the same conveyor lines as the other carriers. Scrap conveyor No. 2, however, in the trim department, accepts only empty scrap carriers. The free loops on this line are entirely different from those in other departments.

Each of the loops on the scrap line has a capacity of exactly two carriers, one in position to be loaded, the other in a waiting position. The carriers are switched off the main line in the regular way whenever the waiting position is open, and move perhaps 10 ft along a spur which is perpendicular to the main line. At the end of this spur, the carrier comes to a dead stop, in the waiting position. From this position there is a short, transverse, pneumatically operated elevator. When a carrier is required for loading, the operator throws a switch that actuates the elevator. This moves the carrier laterally and about 1 ft upward, into the loading position as shown in Fig. 6.

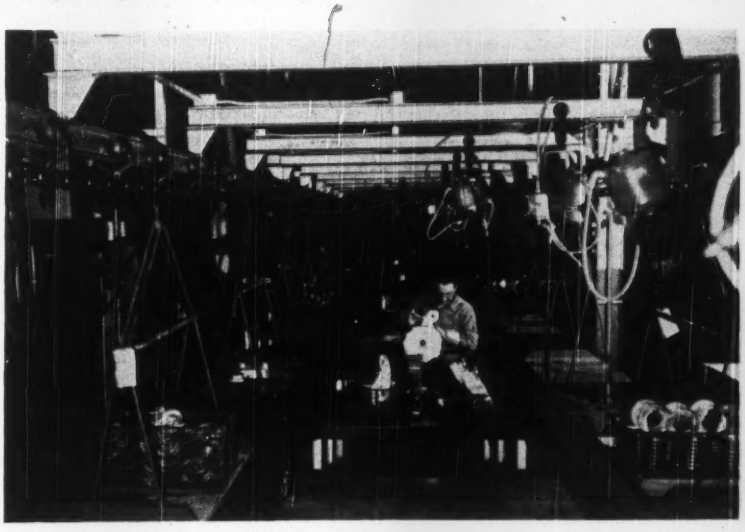


FIG. 5 PART OF TRIM-ROOM OPERATION, SHOWING CONVEYOR WHICH DELIVERS CASTINGS AND SUBSEQUENTLY TRANSPORTS THEM TO INSPECTION AND SHIPPING DEPARTMENTS

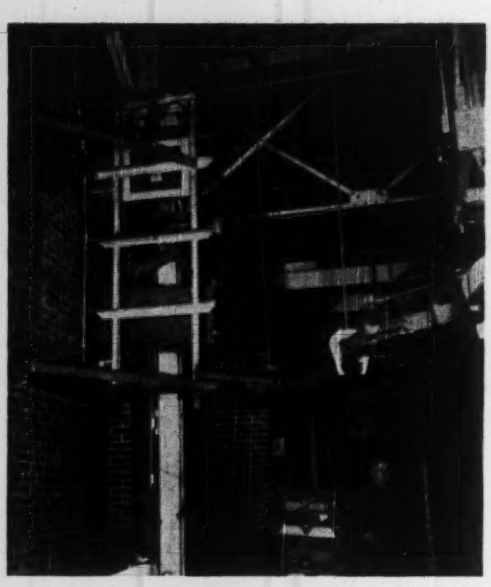


FIG. 7 AUTOMATIC HOIST LIFTS SCRAP HOPPERS FROM REGULAR TO GRAVITY CONVEYOR, ON WHICH IT ROLLS THROUGH DOOR INTO STORAGE

At this time the waiting spur will accept another empty. The upward movement of the carrier makes possible a gravity feed of the loaded carrier back onto the main track.

It may be noted that the loop just described has the effect of turning the carrier around, as it comes off the main track. In order that electrical contacts need not be reversed manually on all the scrap carriers on this conveyor, all empty scrap carriers entering this line are turned 180 deg by an automatic turntable shown in Fig. 3.

The contacts on the scrap carriers are set in such a manner that they automatically by-pass all sidings and loops as they move to the scrap area. There they are shunted onto one of the transverse tracks and held until the scrap is needed.

At that time scrap carriers are moved from the gravity-feed shunt tracks to the No. 5 scrap-disposal conveyor, which carries them over a track scale, and then either to a shipping platform via an automatic hoist, Fig. 7, for outgoing scrap, past open-hearth furnaces for remelting, or to a track siding for tilt-furnace charging. Through an automatic switching arrangement, the man who now handles all scrap can determine the destination of individual carriers, based on the type of alloy they contain.

When a carrier is wanted for tilt-furnace charging, it is switched to the siding and then to a single spur, the end section of which is an elevator. By this means the carrier can be lowered to a short roller conveyor and pushed forward, away from the track. A monorail hoist is then used to transport the carrier to the furnace and return it to the conveyor, where it is rolled back into the lift section of the track.

The switches on the loop in the scrap area are preset to divert empty carriers back onto the main track for the return trip to the trim department. For example, if it is necessary to move unwanted carriers (containing the wrong alloy) onto the loop to get at one which is wanted, the full carrier will make the trip around the loop and feed back onto one of the shunt tracks.

TRANSPORTING CORES

The third type of carrier used is of double- or triple-deck wheeled-tray construction, for transporting cores. Because of the damage that would result if a loaded core carrier was bumped by any other carrier, the contacts are so arranged that they can leave the powered track at only two points. One of these points is, roughly, in the center of the permanent-mold department, the other in the center of the sand foundry. A single-track spur with a lift section (similar to the one in the scrap area) is used to deliver the carriers to the floor. The switches on the spur are so arranged that no more than one carrier can be on it at any one time. Should a loaded carrier reach the spur at a time when it is occupied, the conveyor would stop and remain stopped until the carrier was unloaded. This effectively prevents unnecessary travel of core carriers and reduces the possibility of core breakage.

MECHANICAL DETAILS

Control of movement over the power-and-free system is provided by 335 limit switches, 116 two-way power-operated tongue switches, and 31 manually operated stub switches. Power for the variable-speed drives on each of the conveyors is supplied by either 3-hp or 5-hp electric motors. The nature of the switchovers between conveyors renders the speed of each independent of the speed of the others. Switches are operated by a 110-volt circuit, and the control circuit (which necessarily involves semiexposed contacts) is 24 volts to minimize possible shock dangers to workers.

SAND FOUNDRY

Castings ranging in weight from a few ounces to 2000 lb are produced in the sand foundry, where mechanical equipment is

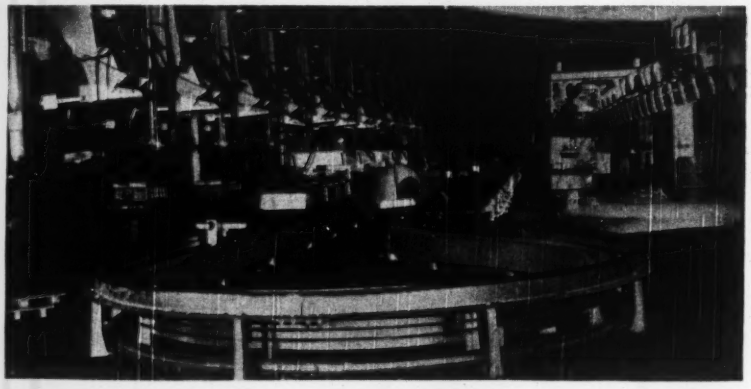


FIG. 8 FLOOR CONVEYOR IN BENCH-MOLD DEPARTMENT
(View shows lower end of one loop of track on which three electrically driven "trains," each with one driver and 18 carriers, move in an 8-min time cycle from molding machines, to pouring, to shakeout.)

employed for handling sand and molds in bench, rollover machine, and floor molding. Smallest castings are made on two loops, one of which is shown in Fig. 8. Each loop incorporates 12 molding machines. Molds are set out and jacketed for pouring on a conveyor train consisting of an electrically operated driver and 18 carriers. Each loop has three trains. The train cars, 22 in. wide and spaced on 5-ft centers are numbered to coincide with the molders' work stations. After the molds are made the trains advance to and stop at the same pouring stations each time they travel the loop. In this manner, molds are located for the pouring of particular alloys. Each loop can accommodate six different alloys or metal-pouring temperature limits simultaneously.

Mold conveyor trains move on a time cycle from the molding stations to a pouring position in the background of Fig. 8. Each of the two bench-foundry loops has six oil-fired holding fuanaces. After the molds have been poured, the conveyor train proceeds to the shakeout position shown at the right in Fig. 8. Here the jackets are removed and the molds are dumped on a long grating through which the sand falls onto a conveyor belt below the floor. Bottom boards are returned to the train, and castings are placed in cars on the main power-and-free conveyor line extending alongside the shakeout station, as shown in Fig. 8. A branch of the conveyor line at this point permits the conveyor cars to be held until they are loaded. Castings are sorted here, those of the same type being placed in individual cars.

The belt conveyor returns sand from the shakeout to a central sand-preparation system serving the two bench-foundry loops. This sand system comprises the usual equipment employed in synthetic-molding-sand practice, including screen, aerator, mixer, and storage bin. Mixed sand is distributed by overhead belt conveyor and plowed off at molding-station hoppers. A duplicate system handles sand requirements of floor and machine molders producing molds for larger castings, this sand also being delivered by overhead belt.

OVERHEAD MONORAIL SYSTEM HANDLES MOLTEN METAL

Metal is melted and alloys determined at the furnaces located in the main building on the one end of the ground floor. This floor contains all the sand-casting operations. Molten metal moves from the furnaces throughout the pouring floor on electrified monorail tracks. Preheated bull ladles of 200 lb, 400 lb, and 600 lb capacity move by push-button control on American MonoTractor propelled carriers which include 1-ton electric hoists. Eight of these carriers serve at present all the hot-metal distribution. They travel at 150 fpm over a track system set up in 12 electrical blocks with power reduced to 110-volt 3-phase for safety purposes. The monorail system includes approximately 4100 ft of track with 69 track switches operated by solenoid-valve air cylinders. These switches also contain colored signal lights to indicate travel through or around curve of switch. Six power-operated monorail cranes serve the heavy-casting pouring floors.

The peculiar problem of transferring molten metal to the third floor of an adjoining building, which contains the permanent-mold operations, was solved by the use of three monorail elevators as shown in Fig. 9. Carriers transporting ladles are dispatched via the monorail track by pendant control to the entrance of the elevator-lift tower. The carriers automatically enter the elevator, rise to the third floor, and run out to a stopping position for push-button movement to holding furnaces. Temperatures of these ladles must be maintained within 30 deg F maximum heat loss, regardless of 3 to 7-min transfer time over trips up to 400 ft for the longest run. The system as set up works adequately and is believed to be unique in foundry operation.

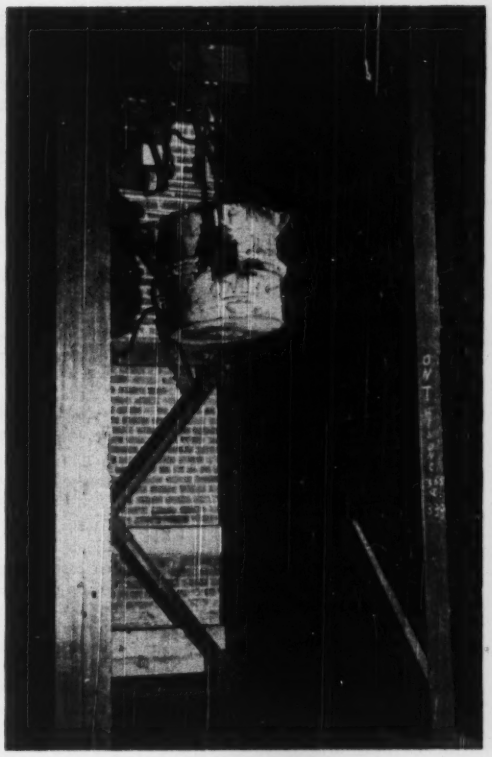


FIG. 9 MONORAIL SYSTEM TAKES BULL LADLE TO ELEVATOR WHICH LIFTS IT TO THIRD-FLOOR PERMANENT-MOLD FOUNDRY WHERE ANOTHER MONORAIL MOVES LADLE FROM ELEVATOR TO ONE OF HOLDING FURNACES

MATERIALS-HANDLING RESULTS

As the materials-handling systems described were installed along with complete modernization of the company works at Bridgeport, it is not possible to express in dollars and cents just how much it may have saved. However, the materials handling as a whole has accomplished the following:

(*a*) *Improved Working Conditions*. The whole foundry is cleaner. There is less heavy lifting. There is more physical freedom for the worker, both real and psychological, because he is no longer penned in by skid boxes of castings, cores, and scrap. Also, accident hazards have been reduced greatly.

(*b*) *Improved Production Schedules*. Delays in waiting for work or handlers have been totally eliminated. By segregating material at its source and keeping it segregated, sorting time has been eliminated. Moving time has been reduced. Castings no longer get lost. Delivery dates can be quoted with greater certainty.

(*c*) *Improved Flexibility of Operation*. The jobbing character of the foundry has been retained in the process of mechanizing the handling setup. Because almost every individual operation has been made more efficient, it is possible to produce a greater diversity of products in more widely varying quantities than ever before—and at lower production cost.

ABSORPTION REFRIGERATION

A Modern Development Using Water Vapor

By A. A. BERESTNEFF

CARRIER CORPORATION, SYRACUSE, N. Y.

INTRODUCTION

DURING the last few decades there has been a growing realization of a great need for an economical heat-operated refrigerating machine for all temperature ranges. The tremendous growth of air conditioning has particularly emphasized this need in the field of "high-temperature" refrigeration applications requiring chilled-water service.

At present there are three more or less extensively used kinds of heat-operated refrigerating machines normally using steam as a heating medium:

1 Steam-driven compression machine (mostly turbine-driven centrifugals).
2 Steam-jet machine.
3 Absorption machine.

The first two may be characterized by high first cost or high operating cost, particularly at medium and low steam pressures. The old absorption machine using ammonia water as a working medium suffers similar handicaps for reasons to be explained. Furthermore, the hazardous nature of ammonia prohibits use of this machine for air conditioning.

In the last fifteen years, several new absorption machines have been developed in an effort to overcome the handicaps of the ammonia system, one produced by Servel, Inc., and another by Williams Oil-O-Matic Company. The Servel unit is available in a capacity of 3 and 5 tons. It uses a solution of lithium bromide in water, the former being an absorbent and the latter a refrigerant. In this machine water is directly expanded in the air-cooling coil. The solution is circulated by a percolator. Efficiency of this unit is comparatively high, making it attractive from the operating-cost point of view. It is operated by gas through the medium of steam which is generated in a special boiler provided as an integral part of the unit.

The Williams Oil-O-Matic unit is made in capacities between 12 and 35 tons. It employs methylene chloride as the refrigerant, and dimethyl ether of triethylene glycol as the absorbent. The unit produces chilled water as the cooling medium, and its efficiency is fairly high. The machine is operated by steam generated outside of the unit.

The foregoing units represent a considerable improvement in design of absorption machines and fit well into high-temperature application. However, they cover only a comparatively small range of low capacities. As a result, until recently there was not any steam-operated machine suitable for the medium and large-capacity range.

In recognition of this situation, a development was started by the author's company with the purpose of producing a fair-sized absorption machine for chilled-water service, economical in first and operating costs. The development work was started in 1941. The first commercial machine was installed in the field in 1945. An appreciable number of machines have been made and put in operation since that time. Culminating this work, the new machine was publicly announced and released as a standard product in May, 1949.

Contributed by the Process Industries Division and presented at the Annual Meeting, New York, N. Y., November 27–December 2, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

PRINCIPLE OF ABSORPTION REFRIGERATION

The principle of absorption refrigeration is based on the affinity existing between certain substances which results in the absorption of one of the substances by the other. A good example is a combination of salt and water, the latter being readily absorbed by salt in the liquid or vapor state. This affinity is measured by the depression of the vapor pressure of water which is the more pronounced the more salt is added to water to form a solution.

If two vessels, one containing salt (absorber) and the other water (evaporator), are purged of air and interconnected, the salt will begin to absorb the water vapor. This will cause more water to evaporate. If water is isolated from any source of heat, the heat needed for evaporation will be taken from the water itself (or brine in contact with it). This will lower the temperature of water (or brine), thus producing the refrigerating effect.

When enough water is absorbed by the salt, the solution becomes liquid; however, it still may retain its absorptive power depending upon the salt concentration of the solution. In a continuous cycle, a liquid solution of sufficiently high concentration is used as an absorbent instead of solid salt. This strong solution enters the evaporator where it picks up the water vapor, Fig. 1. The weak solution is then pumped from the absorber into the generator. Here, upon the application of heat through steam coils, the excess water is boiled out of the solution. The reconcentrated solution is then returned to the absorber to do work again, and the water vapor goes to the condenser where it is condensed and returned to the evaporator to be re-evaporated, thus completing the cycle. Cooling water is used to remove heat evolved by condensation in the absorber

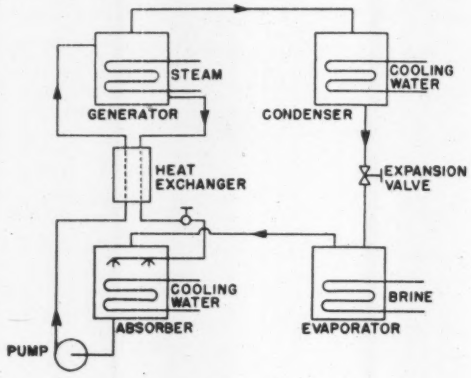


FIG. 1

and the condenser. A heat exchanger is usually provided in which heat is exchanged between the relatively cool weak solution going from the absorber to the generator and the hot solution going from the generator to the absorber. This conserves the heat needed in the generator for bringing the solution up to the boiling point, thus increasing the efficiency of the cycle.

The cycle may remain as simple as in Fig. 1 only if certain conditions regarding the properties of the absorbent and the refrigerant are met. In the old conventional-type absorption machine using ammonia as a refrigerant and water as an absorbent, the simplicity of the cycle cannot be retained because the boiling point of water, though higher than that of ammonia, is not so high as to prevent some water from being boiled off in the generator together with ammonia. After being liquefied in the condenser, it goes through the evaporator and back to the absorber as a liquid without producing refrigeration. As a result, heat is spent in the generator without useful return, which makes the cycle very inefficient.

In order to prevent the absorbent vapor from escaping into the condenser, some additional equipment has to be added to the cycle such as analyzer, rectifier, etc., which makes the machine more complicated and expensive. Although this equipment improves the efficiency, it still remains comparatively low. An attempt to raise the efficiency is further handicapped by the fact that the latent heat of ammonia, although comparatively high, has not the highest possible value. Efficiency is greatly benefited by a high latent heat of the refrigerant. The higher the latent heat, the less solution has to be circulated, therefore the more complete heat exchange between the weak and strong solutions for a given size of heat exchanger, which in turn results in a higher cycle efficiency.

As a result, the ammonia-water absorption machine is characterized by a rather complicated setup, high first cost and high operating cost, which make its application for air conditioning uneconomical even if the characteristics of ammonia did not exclude it.

THE NEW DEVELOPMENT IN ABSORPTION REFRIGERATION

The new absorption machine employs a solution of lithium-bromide salt in water—the latter being used as a refrigerant. The boiling point of the salt, which is a solid at ordinary temperatures, is so high that it behaves as a nonvolatile substance. Therefore there is no vaporization of the absorbent in the generator of such a system and no carry-over of absorbent vapor to the condenser. Since there is no need for additional equipment to keep the absorbent away from the refrigerating part of the cycle, the machine remains extremely simple. At the same time its efficiency is high since no heat is lost for unnecessary re-evaporation of the absorbent. High efficiency is also assured by the high latent heat of water which, in fact, is the highest value known for any substance.

Since the new machine was designed for chilled-water application, it was logical to make it a flash system, that is, to cool the water by flashing a small part of it while it passes through the evaporator and then to use it as a cooling medium in the coil. This eliminates the heat-transfer surface which otherwise would be needed for producing the chilled water, as in the conventional coolers of compression machines, thus reducing the first cost. It also saves the temperature differential needed for heat transfer through the surface, and permits working at a higher suction temperature, which increases capacity and efficiency. In addition to these savings, the absorber and evaporator are combined into one common shell (low side), and the condenser and generator into another one (high side). As a result of all these design features, the new machine is inherently simple, compact, reasonable in first cost, and high in efficiency.

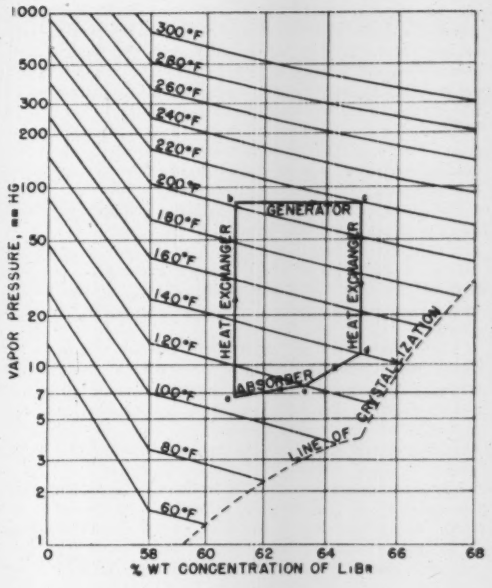


FIG. 2

The relation between the temperature, pressure, and concentration of the lithium bromide-water solution is shown in Fig. 2. The chart shows the location of the crystallization line which sets the limit for the amount of salt which can be dissolved in water at different temperatures. This line, however, does not interfere with the realization of the cycle within the liquid range as it is shown by the cycle outlined on the chart. The cycle can be followed easily in reference to the flow diagram in Fig. 3, explained later.

All the properties of the solution pertaining to heat transfer, such as density, specific heat, viscosity, thermal conductivity, are well known and are rather favorable. Being nonflammable, nonexplosive, and physiologically harmless, this solution is especially desirable for air conditioning. Lithium bromide salt is reasonable in cost and readily available.

In dealing with solutions used for absorption refrigeration, the heat of dilution must be taken into consideration. This is the heat evolved when water is added to the solution, as occurs in the absorber. It is added to the heat of condensation of water vapor and must be dissipated by the cooling water. It must also be supplied in the generator in addition to the heat of evaporation. Evidently the smaller the heat of dilution, the higher the efficiency of the machine. For lithium bromide solution, this heat is reasonable and does not impair the efficiency to any great extent.

Flow Diagram. The arrangement of the machine is shown on the flow diagram, Fig. 3. It consists of two shells, each comprising two elements as previously mentioned; heat exchanger; auxiliaries (solution pump, purge system, eductor); control instruments; and interconnecting piping. The operation of the machine is as follows.

Water to be chilled enters through header (1) and is sprayed into flash evaporator (2). Shell (3) is maintained at a low

absolute pressure nearly corresponding to the temperature to which the water must be cooled. Part of the water flashes, cooling the remainder. It then drains to the suction of the pump (4) which delivers it back to the load. The corresponding pressure in shell (3) is a function of the concentration and temperature of the solution sprayed over the absorber coil (5). The flashed water vapor moves down and is absorbed by the solution. The latter thereby is cooled continuously by the flow of condensing water passing through coil (5) to remove the resulting heat of condensation and dilution.

The diluted weak solution is drained from shell (3) into the solution pump (6). This pump delivers a portion of the solution through the heat exchanger (7) to the generator coil (8), located in the upper shell (9). Steam admitted to the tubes boils off the water vapor previously picked up by the solution in the absorber, thus restoring the high concentration of the solution.

Water vapor boiled out of the solution is liquefied in the condenser coil (10) by the condensing water passing inside the coil, whereby the same water is used in series through the absorber and condenser. The vapor condensate is returned to the evaporator (2) through loop (11) which acts as a seal against the difference in pressure between the evaporator and the condenser.

The reconcentrated solution from the generator passes through the heat exchanger (7) and enters into a liquid eductor (12). Here it is entrained by the other portion of the solution from pump (6) and is delivered back to the absorber spray which completes the cycle. The split arrangement reduces the flow of solution to and from the generator, and therefore the amount of heat to be exchanged in the heat exchanger, making this exchange more complete and thus securing higher efficiency of the cycle.

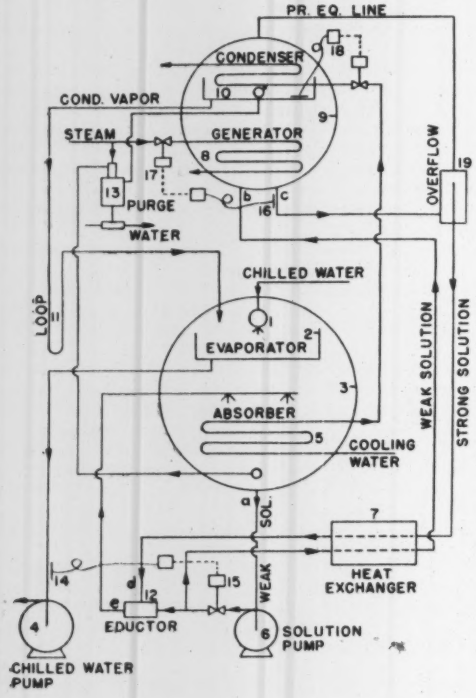


FIG. 3

Both shells are maintained at a high vacuum, one corresponding to the temperature of chilled water, the other to the condensing temperature. To remove air and other noncondensables, a two-stage purge (13) is provided consisting of steam and water jets with an interstage purge condenser. Two purge lines, one from the absorber and another from the condenser, connect the purge with the shells. Both jets require only a small amount of auxiliary steam and water which is negligible compared to the requirements of the machine itself. An important point of the purge is that normally only a small amount of water is purged together with the air. The really expensive part of the solution—salt—is not present in the vapor state and therefore cannot be normally lost through purging.

The solution pump is a small centrifugal pump driven by a medium-speed motor of 5 to 10 hp, depending on the capacity of the unit.

Controls. To control the temperature of the chilled water leaving the machine, thermal element (14) is provided in the leaving water line, Fig. 3. This element responds to falling temperature at partial load and throttles the solution flow (valve 15) in the whole cycle, thereby reducing the amount of reconcentrated solution coming from the generator. This reduces the absorbing power of the solution sprayed in the absorber thereby preventing reduction in the evaporator pressure and, consequently, a further drop in chilled-water temperature. Another thermal element (16) located in the solution leaving the generator throttles the steam supply (valve 17) by responding to the temperature rise of solution when its flow is reduced at partial load. The throttling of steam supply balances the output with the input at any load.

Still another control (18) maintains a constant pressure in the generator-condenser shell by throttling the condensing water to the condenser coil. This, together with the solution temperature, prevents the solution from overconcentrating and holds it at a safe point away from crystallization. The overflow (19), acting as a trap, maintains a constant level of solution in the generator, thus securing a proper distribution of the solution in the whole unit. Several safety controls are provided to protect the unit against any accidental overconcentration and solidification. They automatically shut down the machine by closing off the steam supply when the situation becomes dangerous.

The controls are pneumatic and completely automatic. They regulate the chilled-water temperature within 3 to 4 deg over a range of load variation between 100 and 10 per cent of full capacity.

PERFORMANCE DATA

A view of the machine is shown in Fig. 4. The machine is now being offered in five different sizes ranging in capacity from 100 to 350 tons. A typical capacity characteristic is shown in Fig. 5 as a function of condensing-water and chilled-water temperature. Full condensing-water flow requires $3^1/_2$ gpm per ton; however, reduced flow is permissible with some sacrifice in capacity. The flow of chilled water is not critical, and can be normally established anywhere between $1^1/_2$ to 3 gpm per ton.

The efficiency of the machine is conveniently expressed in terms of performance ratio

$$R = \frac{\text{Useful refrigerating effect, Btu per hr}}{\text{Heat input, Btu per hr}}$$

The performance ratio for the new machine is shown in Fig. 6. It is interesting to note that it increases at partial loads reaching

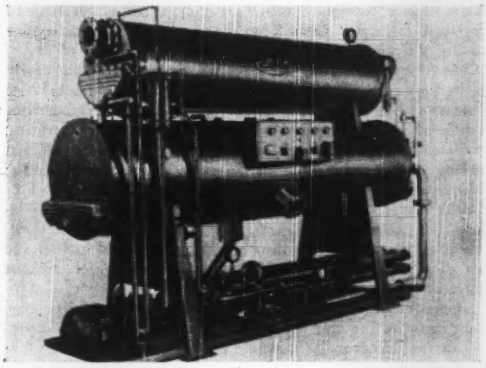


FIG. 4 VIEW OF NEW ABSORPTION REFRIGERATION MACHINE

the maximum at about 70 per cent capacity. This is because the heat exchanger becomes more effective when the solution flow is reduced at partial load. Just for comparison, it may be mentioned that a corresponding value of performance ratio for the ammonia-water machine used at the same conditions will be somewhere between 40 and 45 per cent. From Fig. 6 steam consumption can be easily determined. Adding about 2 per cent for safety, the consumption is about 19 lb per ton per hour at full load and 18½ lb at 70 per cent load. Strictly speaking, the coefficient of performance depends also upon condensing-water and chilled-water temperature. The influence is not large and can be neglected within the range of normal chilled-water service. The chart, Fig. 6, is given for 85-deg condensing water entering and 45-deg chilled water leaving the machine.

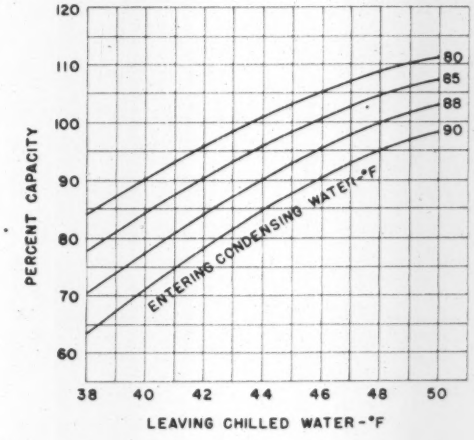


FIG. 5

The machine is designed to give full capacity at steam pressures of 12 psig or higher. Lower pressures can be used with some sacrifice in capacity. Since the steam consumption of the machine is a function of latent heat, it is practically independent of pressure. Table 1 gives a comparison of steam consumption in pounds per ton per hour of this machine and some other steam-operated machines. Condensing water to the machine of 85 F, and chilled water from the machine of 45 F are taken as a basis of comparison.

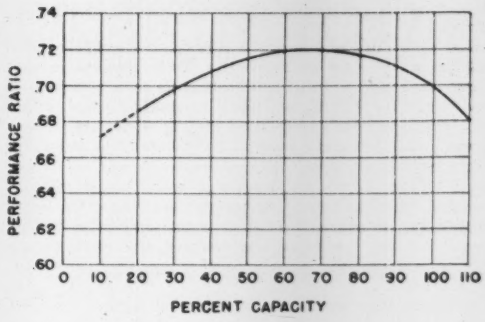


FIG. 6

TABLE 1 COMPARISON OF NEW MACHINE AND OTHER TYPES IN POUNDS PER TON PER HOUR

Steam pressure, psig	10	100	200
Absorption machine	19	19	19
Turbine-driven centrifugal[a]	30	22	18
Steam jet[b]	50–60	30–35	20–25

[a] Vacuum 26–28 in.; size about 150–200 hp.
[b] Condensing water 6–8 gpm per ton.

In case the steam condensate is returned to the boiler or is used in some other way, this machine deserves special credit for an additional saving in fuel. Since the temperature of the condensate from this machine is from 100 to 200 deg F higher than in the usual steam condenser, a corresponding amount of fuel is saved in the boiler. The saving amounts to between 10 and 20 per cent. Table 2 gives space and weight data for five sizes of machines.

TABLE 2 SPACE AND WEIGHT DATA FOR FIVE SIZES OF MACHINE

Nominal capacity, tons		115	150	200	270	350
Over-all dimensions, in.	length	140	175	227	208	252
	width	58	59	60	71	72
	height	103	109	109	120	126
New weight, lb (approx)[a]		8200	10600	14200	18900	24800
Operating weight, lb (approx)[a]		9820	12750	17060	22900	29900

[a] The weight figures are for high-pressure steam. For low-pressure steam, the values are about 8 per cent higher.

APPLICATION

Due to compactness, comparatively lightweight, absence of vibration, and safety of operation, the machine may be conveniently located in practically any part of a building, whether basement, attic, roof, or intermediate floor. The preferred location of the machine is above the chilled-water coil, so-called top location, because it somewhat simplifies the piping in the chilled-water circuit and because it requires a smaller pumping head on the chilled-water pump, since in this case it has to overcome only friction. When the machine and the coil are on the same level, the situation is very much the same as for the top location. Location of the machine below the coil (bottom location) is entirely practical, provided certain precautions are taken in design of chilled-water piping. In this case the pump head is somewhat higher because, due to the

unbalanced conditions, static head will have to be added to friction.

Heat to be dissipated from this absorption machine is about twice as great as for an electrically driven compression machine. However, it does not require twice as large a cooling tower, since for the same amount of condensing water used in both machines, the temperature rise of condensing water through the absorption machine is higher which permits a larger temperature difference between water and air in the tower. Therefore the net increase in tower size is only between 10 and 20 per cent. The heat dissipated by steam-driven compression or steam-jet machine is the same or somewhat larger than for the absorption machine and therefore the cooling tower for the latter is equal or smaller than for the other types.

Wherever more capacity is required than a single unit can offer, a number of units can be used in parallel or series connection on the chilled-water side. The machine can also be used to complement other types of refrigerating machines.

Of particular interest is the attractive steam rate of the machine at low steam pressures. When high-pressure steam is available, further economy can be realized by using the steam first for power generation to drive pumps, centrifugal compressors, or generators by expanding it through a turbine to a low exhaust pressure, and then re-using and condensing it in the absorption machine.

Starting and stopping the machine is a simple operation requiring about the same number of steps as is needed for electrically driven centrifugal compressors. After the machine is started, it runs completely, automatically adjusting itself to any variation of load.

The machine should not be used in an open chilled-water circuit, such as with an air washer, because of an excessive amount of air picked up by the water sprays. Where an air washer is used, a water-to-water heat exchanger is recommended. A similar arrangement may also be needed to protect the machine against excessive dirt or chemicals, or from too high a head above the machine on the side of the chilled-water circuit (100 ft and higher).

Eight years of laboratory test and field observations have provided data necessary to appraise the machine with regard to its durability. The most important facts established so far are that the lithium bromide solution has proved to be chemically stable, and its properties do not undergo any noticeable change after years of use. As to corrosive action, it is practically prevented by controlling the specification of the solution and its inhibiting treatment, as well as by careful choice of materials used for construction of the various elements of the machine.

As far as the chilled-water piping is concerned, direct connection with the machine actually protects the piping against corrosion. This is because air and other gases which cause most of the trouble are almost completely removed from the water by purging while passing through the evaporator. Numerous observations have confirmed this situation.

The foregoing facts lead to the conclusion that the life of this machine will be quite comparable to other types of refrigerating machines now available. In a way it should be even better, since factors such as frictional wear of the moving parts are avoided completely.

ECONOMICS

With regard to the first cost, the new absorption machine is competitive with the other types of water-chilling machines in the tonnage range for which it is designed. Naturally, the first-cost comparison does not include a steam boiler on any of the machines, just the same as the cost of an electric generator is not taken into account in the case of electric drive. As a matter of fact, for this range of capacity, steam is available in practically all cases either from the local boilers installed for heating or from a district steam plant.

Operating expenses for the machine can be figured out easily on the basis of the steam consumption given, and the local cost of steam and power. A survey of electric, fuel, and steam rates in different localities indicates that in many cases the operating cost is quite favorable to the new absorption machine. When making an economic comparison with other machines, the difference in cost of nonidentical items like different sizes of cooling tower, power wiring, steam piping, machine foundations, floor reinforcement, etc., should be taken into account. Likewise, the comparison in operating cost should include the cost of power for driving all pumps and fans which are not identical in power consumption.

Numerous checks made so far indicate that the break-even point in operating cost between this machine and the electrically driven compression machine occurs at approximately the following ratio:

$$\frac{\text{Steam cost, \$/M lb}}{\text{Power cost, \$/kwhr}} = 50$$

that is, wherever the cost of steam in dollars per M pounds is less than 50 times the cost of electricity in dollars per kilowatt a lower operating cost should be expected for the absorption machine.

Regarding the maintenance cost, the experience accumulated so far indicates that it should be equal to or lower than other types of refrigerating machines. The main items of maintenance are cleaning of the heat-transfer surfaces and filtering the solution every year or two.

A WORTH-WHILE ADDITION TO AIR-CONDITIONING FIELD

Each one or a combination of the following conditions makes this machine especially attractive:

1 Localities with low-cost fuel such as in areas with natural gas.

2 Localities with high electric rates.

3 Places where low-pressure steam, especially waste steam, is available.

4 Cities where steam or gas utilities want to build up summer loads.

5 Individual buildings with heating boilers remaining idle during the cooling seasons.

6 Other considerations such as lack of adequate power facilities, lack of space for installing a conventional compression machine or high cost of installing such machine, need of vibrationless operation, etc.

It is apparent that there are many cases throughout the country and abroad where the foregoing conditions do exist. By fitting into these conditions economically, the described machine undoubtedly will greatly widen the use of refrigeration and air conditioning and might, therefore, be considered as an important contribution to this field.

REFERENCES

1 "New Development in Absorption Refrigeration," by A. A. Berestneff, *Refrigerating Engineering*, vol. 57, June, 1949, p. 553.

2 "Development of Absorption Refrigeration for Air Conditioning," by N. D. Berry, Bulletin of the Agricultural and Mechanical College of Texas, no. 1, January, 1949.

3 "Qualitative Requirements of Absorbent-Refrigerant Combinations," by R. M. Buffington, *Refrigerating Engineering*, vol. 57, April, 1949, pp. 343–345, 384–386 and 388.

4 "Refrigeration Fundamentals," editor in chief, B. H. Jennings, Refrigerating Data Book, Basic Volume, ASRE, 6th edition, 1949.

5 "International Critical Tables," National Research Council, McGraw-Hill Book Company, Inc., New York, N. Y., 1933.

QUALITY-CONTROL INDICATOR

An Automatic Version of Statistical Control Charts That Pays Off In Reduced Rejects

By R. C. MILES

REFRIGERATOR QUALITY CONTROL DIVISION, GENERAL ELECTRIC COMPANY, ERIE, PA.

THE quality-control indicator is a new management tool. It enables manufacturing supervisors to survey the quality status of their product at any instant simply by looking at a bank of meters. Each meter tells the quality story for one test or inspection characteristic. One half of each meter dial is red, the other half green. As long as the needles are in the green, the process is operating satisfactorily. If a needle reaches midscale or moves into the red, the supervisor knows that a new trouble exists which affects that particular quality characteristic. Prompt corrective action will materially reduce the number of rejects occurring, thus improving quality and reducing manufacturing losses. Any manufacturer who inspects his product either in part or in whole to determine whether the part or assembly is good or bad has an application for the device. At present it is limited to processes producing 10 per cent rejects or less; the feeling being that any process which produces over 10 per cent defects is in need of basic changes.

The device utilizes statistical control-chart theory. Basically, a study of the manufacturing process is made to determine the normal variations in per cent defective which may occur under controlled conditions. The maximum per cent defective expected under these conditions is called the upper control limit.

THE CONTROL CHART FOR PER CENT DEFECTIVE

For example, Fig. 1 shows a typical control chart applying to one quality characteristic and one set of manufacturing conditions. The average per cent defective or quality level expected is calculated by determining the average per cent defective which has been found in recent production. The per cent defective used should apply to as large a sample of production as is practical and care must be taken to eliminate any quantities in which the process varied from normal. This level is shown by a straight solid line across the chart. The per cent rejects found each day are plotted and the points are connected as shown. The upper control limit is calculated each day and plotted as a dashed line.

In virtually all cases any per cent of defects which falls above the upper control limit is caused by unusual manufacturing conditions. This is commonly termed an out-of-control condition. The purpose of the control chart is to call the unusual conditions to the attention of supervision so that they may be investigated and corrected.

The extent to which it will be practical to use control-chart methods will be dictated by the cost of keeping control charts as compared to the savings accomplished by reducing the per cent defective. There are three principal disadvantages to the use of the control-chart methods. These are as follows:

1 Ideally, calculations should be made and analyzed each time a reject occurs. In most manufacturing operations this procedure will be found impractical from a man-power standpoint and the best that can be obtained will be an analysis of each characteristic at the end of a period of time, usually a day or a shift. This delay in determining percentages which will fall outside control limits allows unnecessary rejects to be built before the out-of-control condition is known and action is taken to find and correct the trouble.

2 The actual trouble may have corrected itself by the time the out-of-control condition is known and no evidence of its existence will be available upon investigation. Experience has shown that troubles of this sort will occur again in the near future unless they are found and corrective action is taken to prevent further occurrences.

3 Man power is needed to collect data and analyze the per cent rejects found to determine whether or not the process is in control.

BASIS OF AUTOMATIC CONTROL CHARTS

The problem of applying control-chart methods to a large number of quality characteristics led to the building of the quality-control indicator, which performs the principal functions of control charts of the type shown in Fig. 1 automatically and continuously. The reject/production ratio is analyzed each time a reject occurs and a signal is given when the upper control limit is exceeded.

Unfortunately, the reject/production ratio applying to the upper control limit is not a direct ratio. Fig. 2 shows the relation of the upper control limit (in per cent defective) to production for a process average of 1 per cent. It will be noted that the upper control limit is far above the process average when the production is small, and it is close to the process average when the production is large. This condition is accounted for by the nature of sampling fluctuations, i.e., the larger the sample, the narrower the band within which sampling variations may be expected to lie.

The reject/production ratio for the upper control limit may also be plotted with the ordinate scale showing "number of defectives." Such a chart for a process average of 1 per cent is shown in Fig. 3. This curve provides the basic information needed for the design of the quality-control indicator. The step curve in Fig. 3 is drawn to provide a working basis since only whole rejects are dealt with.

ELECTROMECHANICAL CONSTRUCTION

The quality-control indicator, shown in Fig. 4, has two basic parts; a totalizer, which counts the number of inspected parts or production, and a characteristic analyzer which counts the number of rejects for one quality characteristic and relates that number to the upper control limit for the production at that time as indicated by the totalizer. The counting is accomplished by means of solenoid-operated rotary stepping relays. The totalizer solenoid is impulsed by closing a set of contacts each time a unit is inspected; the characteristic analyzer sole-

Contributed by the Production Engineering Division and presented at the Annual Meeting, New York, N. Y., November 27–December 2, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

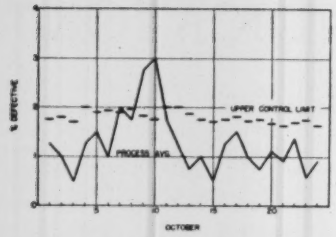


FIG. 1 A TYPICAL CONTROL CHART FOR A QUALITY CHARACTERISTIC WHICH HAS A PROCESS AVERAGE OF 1 PER CENT

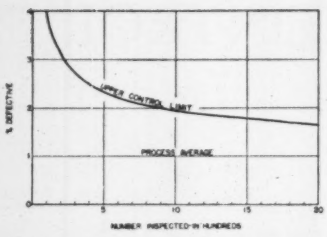


FIG. 2 CALCULATED VARIATION OF UPPER CONTROL LIMIT WITH CHANGES IN SAMPLE SIZE FOR 1 PER CENT PROCESS AVERAGE

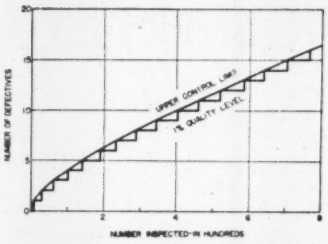


FIG. 3 CALCULATED UPPER CONTROL LIMIT IN NUMBER OF DEFECTIVES ALLOWED FOR 1 PER CENT PROCESS AVERAGE

noid is impulsed by closing another set of contacts each time a reject is found.

The counting operation of the stepping relays is both mechanical and electrical. A numbered dial attached to the shaft of the relay shows the count of units inspected through an escutcheon on the front panel of the totalizer; the count of rejects is shown by a similar arrangement on each characteristic analyzer. Fig. 5 depicts the electrical circuits. The circuit between the stepping-relay contacts operates as a voltage divider. A voltage applied to the end contacts of each stepping relay is divided by means of resistors wired in series to all stationary contacts. The rotary contacts A and B will pick off a different voltage at each step. The voltage between A and (—) d c is divided by a potentiometer to provide an adjustment of quality level between 0 and 10 per cent. The voltage at the movable contact C on the quality-level potentiometer is compared with the voltage at B simply by measuring the current which flows between B and C. The meter chosen to measure the current flowing between B and C is a rugged type in which the needle stands at midscale when no current is present (equal voltages at B and C). If the voltage at B exceeds that at C, current flows through the meter in one direction and the needle deflects to the right in proportion to the voltage difference.

The proper resistance values are selected for the voltage dividers and the level potentiometer so that the meter needle will be at midscale when the reject/production ratio, as reflected by the stepping relays, is on the upper control limit. If the upper control limit is exceeded, the meter needle deflects to the right into the red half of the scale in proportion to the amount the control limit is exceeded; if the reject/production ratio is below the upper control limit, the needle deflects to the left into the green half of the scale.

A vertical line at midscale is labeled "Upper Control Limit." The red area to the right of midscale signals the presence of trouble which needs attention, while the green area to the left of midscale indicates normal conditions. In operation, the needle will start at midscale when the reset button is pushed (at start of production) and progresses to the left in small increments with production count fed to the totalizer. When rejects occur, the needle moves in large increments to the right so that there will never be any doubt as to whether the needle is above or below the upper control limit.

EPIDEMIC CONTROL

The question of controlling epidemics which may occur near the end of a shift has been the subject for many discussions relative to the ideal quality-control indicator. For example, it would be possible to have a process which produced far less rejects than the upper control limit allows for, perhaps, the first 1600 units produced. With this condition a large number of rejects would be required to exceed the upper control limit, and, if those rejects did occur, a temporary out-of-control condition could exist without causing the needle of the quality meter to exceed the upper control limit line.

In the light of practical experience, the epidemic-control problem has become relatively minor for three reasons. First, such cases would happen only rarely; a year's experience with the quality-control indicator revealed no need for an epidemic control. Second, the worst condition that could exist would be the occurrence of a per cent defective near the upper control limit for the operating period (day, shift, etc.). No real basis for alarm is indicated since the maximum number of defectives allowed is still controlled. Third, if the quality meter is ob-

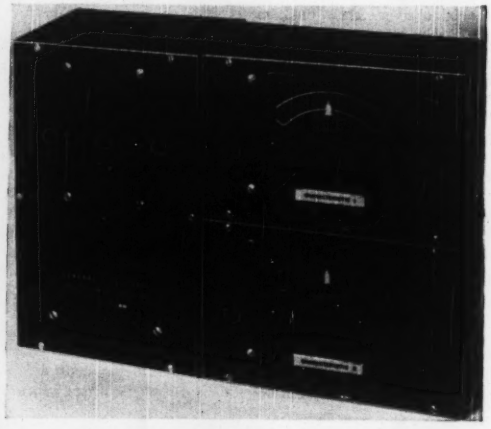


FIG. 4 QUALITY-CONTROL-INDICATOR ARRANGEMENT USING ONE TOTALIZER AND TWO CHARACTERISTIC ANALYZERS

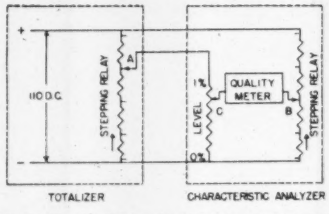


FIG. 5 SCHEMATIC DIAGRAM OF CIRCUITS IN TOTALIZER AND CHARACTERISTIC ANALYZER

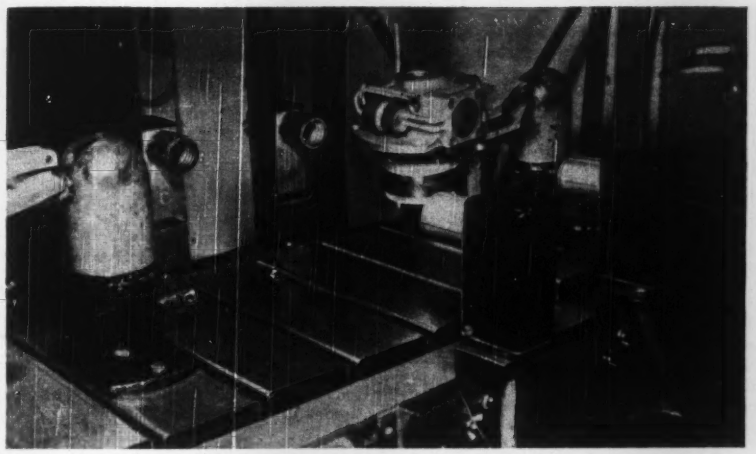


FIG. 7 REFRIGERATOR COMPRESSORS MOVING ALONG THIS ASSEMBLY LINE ARE COUNTED BY ELECTRIC EYES AND MONITORED BY THE QUALITY-CONTROL INDICATOR

served, the needle will be seen to advance rapidly toward the red during the epidemic. A trained observer will investigate such a case.

SUMMARY OF FEATURES

Two models of the quality-control indicator are available and interchangeable. The first operates at any quality level between 0 and 1 per cent; the second operates at any quality level between 0 and 10 per cent. Level may be set readily by a control knob on the front panel of each characteristic analyzer.

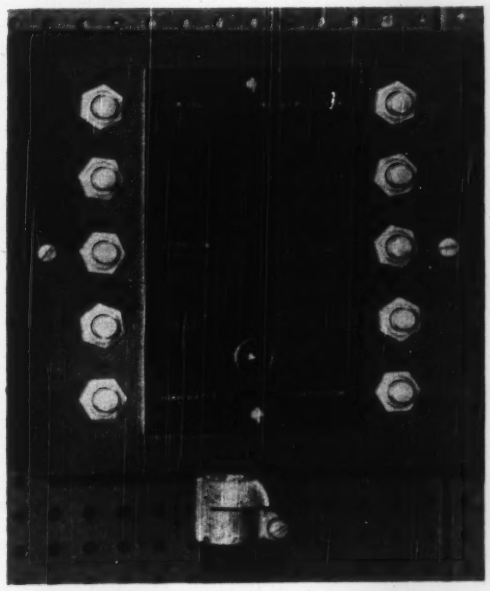


FIG. 6 A TYPICAL SWITCH BOX USED BY INSPECTOR TO ENERGIZE APPROPRIATE CHARACTERISTIC ANALYZER SOLENOID WHEN A REJECT OCCURS

The indicator is accurate to within one reject of the true allowable number at all times. From one to ten characteristic analyzers may be used with each totalizer.

A total production of 2000 units can be analyzed without resetting, and a process out-of-control condition is indicated when the needle on the quality meter is at midscale or in the red portion.

A reset button is provided on each totalizer to zero that unit and all attached characteristic analyzer units at any time, for example, at the end of a day, shift, etc.

An accurate count of total units produced is indicated on the front panel of the totalizer, and a count of rejects for each quality characteristic is available at the front panel of each characteristic analyzer. The counters are attached to the stepping relays and are automatically zeroed when the device is reset.

The totalizer cabinet is 12 × 7 × 6 in.; the characteristic analyzer cabinet is 6 × 8 × 5 in. These cabinet sizes were chosen to provide ease of stacking and a neat appearing installation. The required power supply is 110 volts a c or d c.

INSTALLATION IN THE FACTORY

The method of installing indicators in the factory will vary with the nature and number of characteristics to be controlled. In general, it will be necessary to have one totalizer for each conveyer or production line and one characteristic analyzer associated with each totalizer for each quality characteristic to be controlled. The unit-type construction was decided upon to make it possible to install the exact number of characteristic analyzers needed with each totalizer. The necessary wiring between units is accomplished by plug-in cables at rear of cabinets.

Fig. 4 shows the units needed to control two quality characteristics, which apply to one part or assembly produced on one production line. The location of the characteristic analyzers is very important; the quality meters will serve their purpose best if they can be observed easily.

In the ideal installation, Fig. 7, the count of production will be supplied to the totalizer by a set of contacts, which close

automatically each time a part or assembly enters an inspection station. If the inspection is automatic, a similar arrangement can be used to supply the count of rejects to each characteristic analyzer.

Snap-action switches are employed where manual counting is used; this eliminates the possibility of the operator making a double count. Fig. 6 shows a typical reject switch box which is used at an inspection station. Ten quality characteristics are checked at this point and the appropriate switch button is pushed each time a reject is found.

THE CONTROL OF QUALITY

Once the totalizer units and characteristic analyzers are installed, together with the necessary equipment to feed in units produced and rejects found, the control of quality is greatly simplified. Each characteristic analyzer is set to operate at the quality level which applies and the quality-control indicator becomes the watchdog over quality. Each quality meter shows continuously the quality story for that characteristic. Normally, there would be no need for investigation as long as the needle is to the left of midscale in the green area. Should a needle move into the red portion, an immediate investigation is made.

It is possible also to observe relative quality by noting the deflection of the needles. A needle which is far to the left end of the scale indicates very good quality; a needle which is shifting toward midscale indicates a possible epidemic of trouble, and of course the farther the needle moves into the red the worse the trouble is.

The convenience of the counters is particularly noticeable. The production figures together with the counts of various rejects are read directly at the control station, rather than from various counters on the line and inspectors' tally sheets. See Fig. 8. The keeping of records is thereby greatly simplified.

Experience to date with the quality-control indicator has shown that in virtually all cases of an out-of-control indication, the cause was found at that time and corrective action was taken immediately. The results of the first installation of a quality-control indicator are reported in Fig. 9. Five quality characteristics were controlled. A reduction in per cent rejects was noticeable from the start. The per cent rejects declined steadily until it stabilized at an average process level which was approximately 40 per cent of the level previously held. The reduction in rejects was brought about solely through the combination of out-of-control signals from the indicator and corrective action by the manufacturing supervisors. The quality-control engineers adopted a "hands off" policy as soon as the installation was complete.

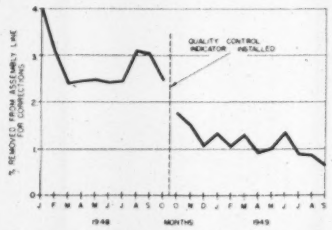


FIG. 9 TOTAL PER CENT REJECTS FOR 5 QUALITY CHARACTERISTICS BEFORE AND AFTER INSTALLATION OF QUALITY-CONTROL INDICATOR

The following points summarize the advantages obtained by using the quality-control indicator:

1 The device is invaluable to factory supervision because it provides automatically a running record of quality and points out troubles at the earliest possible moment.

2 Guesswork is eliminated and supervisors' time for trouble-shooting is utilized with high efficiency.

3 The per cent of rejects is markedly reduced, thereby improving product quality and materially reducing scrap and rework expenses.

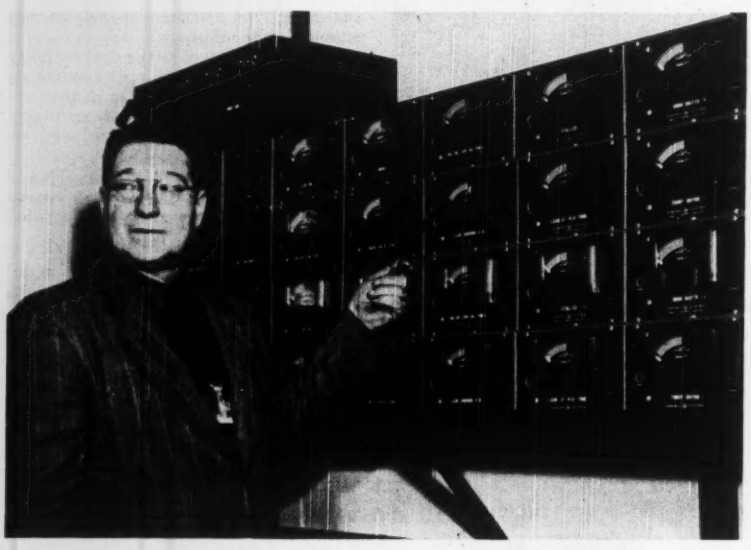


FIG. 8 AN INSTALLATION OF QUALITY-CONTROL INDICATORS FOR CONTROLLING TWENTY QUALITY CHARACTERISTICS ON FOUR PRODUCTION LINES

New Concepts of Abrasive Properties as Affecting Grinding Performance

By H. W. WAGNER

RESEARCH ENGINEER, NORTON COMPANY, WORCESTER, MASS.

DISCUSSIONS of abrasive properties in the past have emphasized scratch or penetration hardness and "toughness" (impact strength). Critical study of correlation between properties and grinding action, and new methods of comparing properties of abrasives, have more recently revealed that our thinking may need some revision.

Important properties of abrasives, now recognized as affecting grinding performance, are as follows:

1 Penetration hardness.
2 Body strength (and other fracture characteristics).
3 Attrition resistance.

Each property will be discussed briefly with reference to its influence. Among the abrasives, primary attention is given to aluminum oxide and silicon carbide, two electric-furnace products most widely utilized in grinding wheels. Other materials are included to exemplify a larger range of properties.

PENETRATION HARDNESS

The first requisite of an abrasive is that it be as hard and preferably harder than the work material it is to grind, so that it can penetrate and scratch the material. The property might be called "static hardness," if the slight movements involved in making penetrations and in making scratches by hand be discounted. For the present purpose at least, penetration and scratch hardness values come in the same order.

The Mohs hardness of artificial abrasives and minerals is determined by short slow-movement scratching. Numbers from 1 to 10 are assigned to certain minerals, but without any exact mathematical relationship between these numbers and hardness numbers, measured by any other method.

The Knoop hardness number is determined by penetration of a diamond point into the specimen. The Mohs numbers and approximate typical Knoop hardness values are given in Table 1 for certain abrasives, natural and artificial.

Knoop hardness numbers typical of some of the harder materials ground by grinding wheels are given in Table 2.

Most of the Knoop values for Tables 1 and 2 were determined with a 100-gram load in the Tukon tester. Those for diamond and glass are estimated roughly for a 100-gram load, from numbers determined at other loads.

BODY STRENGTH

Specifications for suitable body strength and other fracture characteristics are not so easy to write as for the other two properties. If the abrasive is too easily crushed, it will be wasted. The white porous aluminum-oxide abrasive widely used in wheels for the successful precision grinding of delicate steels, is inferior to more sturdy abrasives for heavy snagging, because its body strength is too low.

On the other hand, if the abrasive is too resistant to fracture when its point has become dulled, the wheel face will dull rapidly and generally will be unsatisfactory for grinding in that condition. The face may be resharpened by frequent dressing or truing, but too frequent dressing wastes the wheel and detracts from the economy of grinding. An example of too much resistance to fracture is found in boron carbide. This material is valued highly as a sandblast-nozzle liner and for other uses because of its high penetration hardness and high resistance to mechanical abrasion. However, its high hardness is accompanied by high impact strength which, together with insufficient attrition resistance, makes it fail as an abrasive fixed in a grinding wheel. It is, however, successful in loose grain form for lapping cemented carbides, in which operation it rolls and brings all points of the grain into action.

TABLE 1 HARDNESS NUMBERS

	Mohs no.	Knoop hardness no.
Quartz	7	800
Topaz	8	1350
Aluminum oxide	9	2000
Silicon carbide	9+	2500
Boron carbide	9+	2800
Diamond	10	Greater than 7000[a] no.

[a] Most uncertainty applies to the Knoop number tabulated for diamond. This uncertainty, however, is not highly important here, because the real value stands very high above those for the other materials.

TABLE 2 KNOOP HARDNESS NUMBERS FOR HARD WORK MATERIALS

	Knoop hardness
Common glasses (depending upon composition)	500 to 600
Hard steel, Rockwell C60.5	740
Cemented carbides	1400–1800
Tungsten carbide (not cemented)	1880
Vanadium carbide (such as in high-carbon, high-vanadium, high-speed steel)	2080

Optimum impact strength is that which permits fracture of the abrasive when, and only when, the point has been worn by attrition (glazed) to a certain degree of dullness, or has become loaded to a certain degree. The abrasive is "loaded" when particles of the work cling to it. Fracture then permits continued use of the same abrasive grain rather than immediate wastage of it through redressing.

In passing, it may be mentioned that virtue is attributed to some aluminous abrasives in certain applications, because of the shape of fracture. A blocky rather than conchoidal fracture is thought to be more effective in shedding the impediment of load when snagging soft metals.

A traditional concept has been that aluminum oxide is "tougher" (has higher body impact strength) than silicon carbide. Recent investigations question this concept.

Various methods of measurement, depending on conditions, sometimes rate aluminum oxide stronger, and sometimes rate silicon carbide the stronger of the two, just as various methods of hardness measurement sometimes fail to agree, as among different materials. The majority of evidence, however, gives the higher impact strength to silicon carbide, when comparing dense single-crystal grains. This is in the same direction as penetration hardness, a logical expectation.

Ratings of relative body strengths of four abrasives are given in Table 3.

TABLE 3 BODY STRENGTH

Aluminum oxide	Silicon carbide	Boron carbide	Diamond
Moderate	Moderate plus	High	Very high

Actual measured values of body strength depend largely upon such factors as the amount and distribution of impurities, the amount of micropores, the size and structure of the crystals, the spatial relationship of impurities and micropores to the crystal, and on the shape of specimen. The ratings in Table 3 are for dense single-crystal grains, with effects of variations in the various factors reduced to a minimum.

ATTRITION RESISTANCE

"Attrition resistance" is the ability to maintain a sharp point in grinding when fracture of the abrasive does not occur. A less brief designation is "resistance to point dulling." Low resistance results in the rapid formation of flats on the abrasive points and in a glazed (dulled) wheel face.

Attrition wear is akin to molecular wear and, when greatly magnified, may be likened to the normal wear of a piece of chalk used for writing on a blackboard. On the other hand, when the stick of chalk breaks, we have fracture due to low body strength.

Attrition resistance, obviously, is related to penetration hardness. One may then wonder why a distinction is drawn between the two properties. Here is where one of the new concepts appears.

Relative attrition resistance, as affecting point wear, changes as we change the character of the work ground. Furthermore, the changes cannot be accounted for entirely by hardness values of the work materials. Therefore we must conclude that some other factor enters to affect point wear. That other factor apparently is the degree of solubility of the abrasive when in contact with the specific work material. The rate of solution is affected by the temperature of the interface during grinding. "Interface" is the area of contact between abrasive and work.

The orders of attrition resistance (presumably as affected by penetration hardness and solubility) of four abrasives on three work materials are indicated in Table 4. These evaluations were determined under equal pressure, not forced feed, in air.

TABLE 4 ATTRITION RESISTANCE

Attrition resistance of:	On hard carbon steel	On hard cast iron	On glass
Aluminum oxide	High	Moderate	Very low
Silicon carbide	Moderate	High	High
Boron carbide	Low	Low	Moderate
Diamond	Very high	Very high	Very high

The comparisons tabulated are among abrasives on the same work material, not necessarily for the same abrasive on different work materials.

Relative resistances of the abrasives are probably similar on most hard and soft steels to those on hard carbon steel, and are probably similar on other ceramics and stone to those on glass.

Attrition resistance is affected also by the medium in which the abrasive-work contact occurs. Of the mediums compared, the resistance is lowest in water, intermediate in dry air, and highest in grinding oil. This oil also reduces loading of the wheel face to a high degree.

CORRELATION OF EFFECTS OF PROPERTIES

Estimated suitabilities of two properties of four abrasives, for stock-removal grinding, on three classes of work materials, according to present knowledge, are given in Table 5. Rating of body strength in Table 5 is not always relative to other abrasives but is in reference to that needed to accompany the attrition resistance on the respective work material. Penetration hardness as a separate property is omitted from the table because its effect is included in attrition resistance. Also, all four of the abrasives are generally harder than all three classes of work materials.

TABLE 5 SUITABILITY OF PROPERTIES

	Soft and hard steels	Hard cast irons	Ceramics and stone
Aluminum oxide:			
Body strength	Suitable	Suitable	Too high
Attrition resistance	Suitable	Too low	Very much too low
Silicon carbide:			
Body strength	Too high	Suitable	Higher than optimum
Attrition resistance	Too low	Suitable	Suitable
Boron carbide:			
Body strength	Too high	Too high	Too high
Attrition resistance	Very much too low	Very much too low	Too low
Diamond:			
Body strength	Suitable	Suitable	Suitable
Attrition resistance	Excellent	Excellent	Excellent

The top suitability rating of diamond does not necessarily mean that it is most economical. Its high cost and the problem of bonding it prevent it from being most economical for grinding many metals. Its economy has been proved most widely in grinding of ceramics, stone, and cemented carbides.

The suitability comparisons of abrasives in Table 5 are for the majority of stock-removal operations when the abrasive penetrates the work and removes chips of typical size. Overall suitability might be measured by the rate of cut under equal pressure when the grade of each wheel is chosen to keep the rate of wheel wear the same for all.

One exception to Table 5 comparisons is in cylindrical grinding of 18–8 stainless steel for which silicon carbide is often employed. A near exception is rough-grinding of glass with an aluminum-oxide wheel which becomes rapidly glazed but continues to remove stock at a surprising rate: stock removal here is regarded as accomplished more by rubbing and less by penetration of the abrasive into the work than occurs in most grinding.

When the requirement changes from fast stock removal to a fine finish, the suitabilities of two abrasives sometimes reverse. Low attrition resistance, a liability in stock removal, may become an asset for fine finish. Silicon carbide in fine wheels is often used to produce a "mirror" finish on hardened steel rolls. A glazed aluminum-oxide wheel puts a much finer finish on glass than does a sharp silicon-carbide wheel.

SUMMARY

An abrasive yields higher grinding value when:

(*a*) Its penetration hardness is higher.

(*b*) Its body strength permits fracture (self-sharpening) at the proper degree of dullness.

(*c*) Its attrition resistance is higher in contact with the particular work material ground.

The new concepts presented are as follows:

Aluminum oxide fractures more readily in grinding than does silicon carbide.

Dulling of abrasive points is influenced by solubility of the specific abrasive in the specific work material which is ground by that abrasive.

Dulling of abrasive points is influenced by the medium surrounding the operation. Dulling is retarded most by using grinding oil as the medium.

AVIATION AS AN INSTRUMENT OF PEACE

By HUGH L. DRYDEN

DIRECTOR, NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS. FELLOW ASME

THE ENGINEER'S CONCEPT OF PEACE

THE most challenging task of our time is not the development of nuclear power, interplanetary travel, or any other advance in the conquest of the physical world. It is rather the building of a peaceful world, a goal which appeals alike to statesmen, scientists, engineers, and to men in all walks of life wearied by wars, hot and cold. It is not surprising that engineers seek to contribute not only to the molding of Nature to the will of man, which is their normal function in a peaceful world, but also to such tasks within their skills as will contribute to the restoration and maintenance of peace. Perhaps the architecture and construction of a peaceful world are the primary responsibility of statesmen, but engineers desire to assume their appropriate responsibilities in supporting the work of responsible leaders. Some engineers may even grow to the stature of statesmen and share the burdens and privileges of leading the world toward peace.

The concept of peace or of the peaceful world, which is our goal, would seem to require no explanation, yet words are often elusive in meaning, especially those words which become popular slogans. A peaceful world is obviously a world in which there is no war, but such a negative description conveys little knowledge of the characteristics of the world presumed to fulfill our deepest longings. The descriptions given in the standard dictionaries even suggest that peace is not a desirable environment for engineers. May I read them to you: "a state of quiet or tranquillity; freedom from disturbance or agitation; calm; repose."

The engineer's concept of a peaceful world is somewhat different from these. The engineer's peaceful world is a beehive of activity, of turning wheels, or moving earth, of smoking factory chimneys (at least until he eliminated the smoke to secure improved efficiency); not a lifeless landscape, a quiet country graveyard, or a deserted and crumbled city. His peaceful world does not resemble that of a gas at the temperature of absolute zero, at which the molecules of the gas are eternally at rest. His peaceful world has a high internal energy with individuals moving vigorously to and fro in a free and random manner, but capable of being marshaled and directed to produce power for useful ends and of a magnitude far greater than that associated with any single individual. Through suitable tools, instruments, and machines, the peaceful world is a world of ever-growing human accomplishment, not a static but a dynamic world. Such a goal evokes a response from men who feel the challenge of the needs of the world. Let us leave to those grown old and weary in labor, the static concept of a peaceful world where there is no task for the engineer.

The very existence of such an activity as aviation is itself proof of the dynamic nature of the world in which we live. Born within the lifetime of many of us, it has grown, slowly at first, but with ever-increasing pace until it now occupies an indispensable position. Its tremendous impact in our civilization creates the impression that it is a living organism, with an existence and growth independent of the minds of the men who created and developed it. Yet aviation is but an instrument and tool of the human race.

Presented at a luncheon in connection with the 1949 Annual Meeting, New York, N. Y., Nov. 29, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

INSTRUMENTS AND TOOLS

The relation of man to his tools has long been of interest, not only to engineers, but to all students of man and society. If one sees for the first time a modern printing press, or rolling mill, or catalytic cracker, one marvels that the human mind could conceive a device so complex. Of course, no one human mind did. The present devices are the products of the minds of many men, some long since dead. By standing on the shoulders of the past and by organized co-operation of many men, intricate and powerful tools can be still further developed. Since the creation is thus beyond the ken of most individuals, we have seen the growth of fables of machines turning against men to bring harm rather than good.

It cannot be denied that large numbers of individual members of the human race have had their lives profoundly affected by the inanimate products created and developed by a comparatively few men. But this influence of the tools on the lives of their creators and users should not blind us to the fact that the inanimate devices are but tools intended to be used by the human race for its benefit.

The function of an instrument or tool is to accomplish some purpose or task conceived by the human mind. The tool may be more or less suited to certain physical tasks, but its use and the results obtained depend on the intervention of men. The tool itself does not determine the task for which it will actually be used and the tool cannot be held to account for its effects on human welfare. Thus on closer analysis, a study of the effects of various instruments and tools on human society will be found to be really a study in human relations between one group of men and another, the instruments themselves being capable of being used either to promote human welfare or human misery.

The instruments and tools of peace are accordingly hardly distinguishable from the instruments and tools of war. Swords and plowshares are based on the same steel industry. Explosives will either destroy cities and the people in them or quarry the stone to build the cities larger. The airplane is not the invention of the devil, but just another tool to serve the purposes of mankind; whether for good or evil, for war or for peace is determined by the user.

AVIATION AS AN INSTRUMENT

Similarly, the whole physical apparatus of aviation is but a tool of mankind to be used as the human race or, more properly speaking, its appointed leaders may desire. As an instrument, it has certain properties which are worthy of brief discussion.

The first important quality is that of speed, a quality that contributes greatly to the utility of any tool. To an audience

of engineers, it is perhaps unnecessary to belabor this point. The ideal tool is one which produces the desired result as fast as the user can determine what he wishes to accomplish. Absence of time lag in any mechanism is a great virtue; control problems are easier and the output is greater. Aviation has the quality of speed. If Mr. Acheson wishes to confer in person with Mr. Bevin, he can do so with a delay of only a few hours. It would be a more useful tool if the speed were still higher. Three or four hours would be better than eleven for the trip from Washington to Los Angeles.

The second important quality of aviation as a tool is its ability to remove natural barriers. So far, this quality has been successful only with the physical barriers of space and time. The ability to travel in three-dimensional space to any point on the surface of the earth is becoming of increasing importance in removing other barriers. Peoples of different custom and tradition are brought into more intimate contact. At first, these contacts may bring friction, but with increasing skill in the use of the tool, mutual understanding may be promoted, sources of friction may be removed, and the benefits of human knowledge and skill may be more widely disseminated.

Aviation has proved to be a versatile and powerful instrument to perform many tasks in a peaceful world. The first air mail was carried in a demonstration flight in England between Hendon and Windsor on Sept. 9, 1911, to celebrate the coronation of King George V. A couple of weeks later, Earle Ovington carried mail for a week between Nassau Boulevard and Mineola, Long Island, with the co-operation of the Post Office Department. The first regular civilian air-mail service in the world began on May 15, 1918, when Lieut. George Boyle and Lieut. Torrey H. Webb inaugurated service between Washington and New York in Army airplanes carrying public mail cleared through the Post Office in the usual manner. In 1919 steps were taken under the direction of Otto Praeger to create a transcontinental route for air mail, and, on July 1, 1924, the mail went all the way by air on regular schedule. On March 1, 1928, regular mail service was inaugurated across the Atlantic between Africa and South America. In May, 1939, Pan American Airways began mail service across the North Atlantic via the Azores. On March 15, 1948, international air-parcel-post service was established, followed on Sept. 1, 1948, by domestic air parcel post. Today, about a ton of parcel post is being shipped internationally every 24 hours. In December, 1948, an average of about 220 tons of air mail was transported every day.

The carrying of passengers in airplanes began in the early days of the flying circuses at county fairs when the custom originated of taking up passengers for "joy rides." Following the first world war, many ex-war pilots continued the development of passenger carrying by the use of Jennies operating from pasture to pasture, creating a sizable aerial taxi business. In 1925, some 344 operators reported to Lester Gardner a total of nearly 7 million airplane-miles. On Aug. 25, 1919, regular airplane passenger service began between London and Paris. In America, the first regular air passenger service was between Key West and Havana—the first run being on Nov. 1, 1920. In 1932, the total passenger-miles amounted to 127,433,000, increasing to 1,670,935,000 in 1943, and to nearly 6 billion in 1948, of which about 2 billion were on the international airways. In domestic operations, the airlines were responsible for 35 per cent of the first-class travel market as measured in passenger-miles. About 40,000 persons are transported by air every day.

To the carrying of passengers, there has been added air express and air freight, amounting to about 145 million ton-miles in 1948, an increase of 50 per cent over 1947.

Aerial transport is the most familiar peacetime task of the airplane, but other tasks, less spectacular, are of the greatest importance to our economy. The extension of human vision by elevation of the observer, especially when the observer is also assisted by binoculars and cameras, is beneficial in many applications, from the observation and direction of the fighting of forest fires to the patrol of power lines and oil pipe lines. No power company or railroad would think of starting work on a new line without making an aerial survey of the alternate routes. Such a survey is cheaper, gives much more detail, and can be conducted in secrecy. The tools of aerial surveying were highly developed for photographic reconnaissance during wartime, but crop reporting, flood control, soil conservation, geological and archeological prospecting, and town planning have greatly benefited.

Another peacetime use of the airplane is insect extermination. In 1921, Lieut. J. A. Macready of the Army Air Service, as the Air Force was then called, co-operated with entomologist C. R. Neillie to spray some trees infested with caterpillars. A little later, the dusting of cotton crops from the air became a common method of combating the boll weevil. The method has been extended to fruit trees and then crops, and to the control of mosquitoes and flies by DDT sprays. The agricultural and public-health applications of aerial spraying are numerous and few have been exploited.

The idea of using airplanes for assistance and rescue operations is almost as old as aviation itself. As early as 1915, three Coast Guard officers at Hampton Roads, Va., conceived the plan of an air patrol to search for overdue ships along the Atlantic coast. The experiment, carried out with a borrowed airplane, was successful and may be said to mark the beginning of the air-sea rescue work of the Coast Guard. The helicopter has been of pre-eminent value in this field. On land, as well as sea, the airplane has been the means of saving many lives by the rapid transport of sick or injured persons from remote regions, or by bringing medicines, doctors, and nurses to the patient where their other methods of transport fail or require too much time.

Policing from the air, skywriting, serving as repeater station for television transmission—all these and other tasks yet unborn are jobs adapted to the airplane as an instrument of peace.

AIR POWER—INSTRUMENT FOR PEACE

The people of the world long for an environment in which aeronautics can be an instrument of peace, as just outlined. But, so long as there are human disturbers of the peace, the most important use of the airplane is as an instrument for war, rather than as an instrument of peace. Yet, is not the revolver and club of the policeman a familiar instrument of peace in troubled surroundings? Many will think this reasoning specious and a form of rationalization. Having tried the road of disarmament once, many responsible and thoughtful persons believe that it is safer for our nation to try the road of strength, especially to develop and maintain air power. The lesson of World War II is clear—we must not, we cannot, permit ourselves to become a second best in air power if we wish to survive as a free people.

The immediate task is that of the revolver of the policeman to discourage the use of force by others because of the ability to retaliate with force on an aggressor. This is the concept behind our building of long-range bombers and atomic bombs. I firmly believe that we will never start a war, but we must have the instruments of defense. The most immediately useful ones are airplanes with suitable offensive armament. They are as surely the tools of peace as any other material creation of man, if the tools are employed by peace-loving men to enforce peace. Air power is, however, much more than a collection of airplanes-in-being which are becoming more obsolete every

(*Continued on page 234*)

The OBLIGATION *of* MANAGEMENT *to* PROVIDE LEADERSHIP

By FREDERICK S. BLACKALL, jr.

PRESIDENT AND TREASURER, THE TAFT-PEIRCE MANUFACTURING COMPANY, WOONSOCKET, R. I. FELLOW ASME

THE subject designated for the 1949 Towne Lecture can hardly be termed a novel one. The obligation of management to provide leadership! It has inspired preachers to sermons, public speakers to endless oratory, authors to so many volumes that I shall soon have to devote a special section to the mounting collection in my own private library. Its very phrasing conjures up vague and grandiose sentimentalities dealing with pension plans, guaranteed employment, sickness and health insurance, socialized medicine, unemployment pay, group insurance, rest periods, recreational activities, vacations, paid holidays, shorter hours, higher wages, profit-sharing plans—in brief, with human welfare, social security, and the brave new world. These, according to the messiahs of the New Era, will lead us from darkness into light and inaugurate a period of industrial amity such as the world has not yet known. Of course a certain amount of this philosophical dissertation has its genesis in political oratory not without a modicum of ulterior motivation; yet a goodly portion of it emanates from the ranks of management itself, usually accompanied by the thesis that all of these things are going to be inevitable in an economy too obviously conditioned by the socialist philosophy, so management might as well adopt the whole program and thus appropriate the credit for it.

Now let it not be thought that I decry all of these lofty objectives. Neither do I preach a strictly materialistic philosophy. Man does not live by bread alone; the tenets of leadership in whatever sphere of activity certainly transcend mundane considerations. The spiritual and social well-being of the community, for example, are vital to the pursuit of happiness, which is one of the inalienable rights envisioned by our Declaration of Independence. Even if we are to embrace a purely practical approach to management problems, the support of community activities by business leaders and their contributions to the welfare of their fellow beings, are to no inconsiderable extent in the nature of bread cast upon waters. Just as honesty is the best policy, so undeniably is a decent sense of the obligations of a business to the nation and to the community in which it is situated. But I shall not deal primarily with these so-called problems of human welfare—indeed with most of them I shall not deal at all—not because some of them may not be wholly worthy objectives, not even because management, at one time or another, may not have to wrestle with them most arduously. I simply refrain from their analysis because I do not believe that they constitute in any sense of the word the essential kernel of management's obligation to leadership. Indeed, there is ample documentation for the case that a management too preoccupied with these considerations is in danger of failing to exercise that primal duty implied in the very term "business management"—the obligation to manage its business so that it will succeed. Business must succeed or fail, and if it fails, then the only possible source of the wherewithal to bring even the worthiest of these other objectives within reach is utterly lost.

Events abroad render it all too apparent that the United States is becoming the last bastion of free enterprise. If the American way is to survive, management, especially, must exercise enlightened forward-looking leadership of the type which will bring to the institutions which it directs a vibrant continuing material success. Only through such success can we maintain our potential for progress. I submit that no greater obligation rests upon the shoulders of American business management than to prove to the world that the American system will work, that it is the best system, that it is the best because it alone will bring to its citizens a standard of living and an opportunity for the pursuit of happiness unmatched elsewhere on the entire globe. Any other approach to the real obligation of management to leadership seems to me to beg the question. It attaches a vicious and enervating importance to security and insulation from the rigors and risks of vigorous competitive life. President Wriston of Brown University has aptly characterized this misemphasis of security as "the sentimentalism of democracy."

In our island of individual freedom, surrounded as we are by austerity, socialism, fascism, and dictatorship, can anyone doubt that this is the paramount task of American business enterprise? Russia is confident that our system simply will not work. Many indeed aver that she is biding her time to pounce, vulturelike, upon our moribund carcass when the swings of the business cycle plunge us into a last devastating depression.

I am convinced that the salvation of all that has made our nation great is basically dependent upon our proving our mettle in the test in which we are engaged with alien philosophies. Every one of these stems either from Marxian or Fabian socialism, or both. In other words, they are economic philosophies, just as the American Free Enterprise System is an economic philosophy. It follows that the ideological struggle in which we are joined is a contest of economic ideas and ideals. How ironic that their systems, which have plunged half the world into poverty, austerity, or dictatorship, should be clothed with an aura of humanitarianism wholly false, while ours, which has brought to our people the highest standard of living in all the world and the greatest measure of happiness, should be regarded as materialistic. Is it not then clear that we *must* make our system work? If, as I believe, this is what it will take to preserve our principles of government, the incentives provided by our individual enterprise system, our very liberties as free men, then surely management can set for itself no more lofty objective than to make the American way succeed.

How then shall we implement our purposes and in what order shall we write the agenda of management's obligation to leadership? First and foremost, I suggest that leadership, like charity, should begin at home. The primary obligation of any manager is to get his own house in order and keep it so. This requires eternal vigilance and a constant spirit of healthy skep-

[1] The 1949 Towne Lecture, an address before the ASME Management Division Luncheon, November 30, 1949, during the Annual Meeting, New York, N. Y., November 27 to December 2, 1949, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ticism with respect to all phases of the business organization, its personnel, its methods, and its policies. The opportunity for leadership in this situation is essentially an educational one. In such a program, management must set the pace for wisdom, judgment, and hard work. What's the matter with work, anyway? Are we forgetting the old copybook maxims and growing soft? It is vital that the entire organization, from president to office boy, shall be imbued with the will to accomplishment, the thirst for improvement, the fighting spirit of an athletic team. I sometimes think we overplay the theory that every organization is the lengthened shadow of a man. A good captain is a tremendous asset, to be sure; but certainly, in ninety-nine cases out of a hundred, the able captain is good primarily because he knows how to inspire teamwork. In the ultimate analysis, the game of business is won not by star quarterbacks, but by the co-operation of a corps of men and women working in harmony and a common spirit of endeavor, as a smoothly functioning unit. Management's greatest challenge in its internal problems is to create such a team.

If management's primary obligation is to manage, certainly its secondary obligation is to insure the future by providing ample reservoirs of management talent in the lower echelons. This involves a fine sense of judgment in the delegation of responsibility. The manager who reserves to himself all of the difficult decisions, fearing to divide responsibility for success among the key men of his organization is failing in an important tenet of leadership. This is true even though his own decisions be characterized by the wisdom of a Solomon, their implementation be rich in accomplishment. It is clear that management must take the lead in pursuing this policy if it is to be followed consistently throughout the organization. Someone has said that a good manager is one who wears a worried look on the face of his assistant! There's something in it. Certainly the organization which has not been inspired by its head to share in the worrisome problems of the enterprise is not functioning as a team or realizing its potentialities. The younger personnel especially should be encouraged to take responsibility and use it. Men grow in stature with the assumption of responsibility, and it is through such a process that tomorrow's managers are made.

The management which plays a leading role in the meetings and councils of its trade associations, the professional societies in its own field, the conventions and exhibitions pertinent to its activities, not only is broadening its own point of view; it is setting a vital and constructive example to the younger members of its staff. In this sort of activity, top-management should take care not to become a one-man show. Other members of the staff, and particularly the younger group, should be given the time, the encouragement, and not least of all the necessary expense account to be in the thick of all these things. The gains which accrue to industry at large from co-operative effort of this sort benefit each member of industry enormously. The time and money which business devotes to them is the soundest possible investment. Forward-looking management today recognizes the value of intra-industry and professional contacts and fosters them. The sharing of ideas which is made possible by conferences such as the Annual Meeting of The American Society of Mechanical Engineers, for example, is of incalculable value to those who engage in them.

Visitors from other shores never cease to marvel at the open-door policy which is practiced almost universally by American industry. In other lands, a trip through an industrial plant has to be planned in advance. More than likely it has been the subject of no little negotiation before it is accomplished. Here in America we embrace the thesis that we let in more light than we let out when we raise the curtains on our activities. This striving for light through the exchange of ideas is so commonplace in our country that we fail to realize that it is something relatively new in the world. Perhaps there is a natural human tendency to harbor the lessons one has learned, especially if they are believed to be in the nature of new discovery, whether material or intellectual, but it is an easy way to get into a rut. It is no accident that the leadership in the professional societies, the outstanding commercial and trade organizations, and the other groups which devote their efforts to wrestling with the problems of our national and international economy is exerted predominantly by representatives of successful businesses. The management is shortsighted indeed which does not urge the members of its staff to sharpen their wits by taking part in public and professional activity of this nature. Such participation is rewarding in the extreme. Inevitably, it heightens the mental stature of those who have a hand in it to the enduring benefit of the institutions which they represent.

If I were asked to name the primary requisites for accomplishment in this life, I should list them as intelligence, initiative, and judgment. Intelligence—the ability and courage to think, which is one of the rarest of qualities. Initiative—the habit of doing things without being told. Judgment—a little more difficult to define, but perhaps the best definition is a good batting average in your guesses. They won't all be right, but after all, George Kell of the Detroit Tigers, who led the major leagues during the past season, registered base hits only a little over 34 per cent of the time. The assumption of responsibility by young executives under wise and mature guidance, and the affording to them of liberal opportunities to rub shoulders with the world, will go far in developing these vital qualities of leadership.

Thus far I have dealt only with those affairs which are concerned with the internal operation of business enterprise and the contacts of business management with others within its own field. But now I shall turn to management's obligation to leadership in matters not immediately related to business problems. Perhaps thereby I may gain a measure of indulgence from those who concluded from my opening remarks that the Golden Rule had no place in my industrial philosophy, that I was prone to reject the idea that each man is his brother's keeper. Nothing could be further from the truth. I regard it as one of the essential obligations of management to take a zealous part in those community, regional, and national activities which are devoted to the maintenance of our country and our world as a sound and decent place in which to live. Let it not be thought that such concerns are inconsistent with my thesis that management's primary obligation is to make its business successful. American business enterprise will prosper and progress in more or less direct proportion to the maintenance of our high standard of living, which is the envy of all the world.

Can anyone believe sincerely that our people will be happier, that their living standards will be raised, that their accomplishments will be greater, if we let a paternalistic government do all of the things for us that any red-blooded man knows he ought to do for himself? England is trying it, and look what is happening to her. If the process continues, she will lose her very character. To quote from the *London Times*, "The walls of the prison close in daily." The stultifying effect of transferring from the individual to the all-powerful state responsibility for production, finance, housing, public health, retirement insurance—in brief, the adoption of the whole miserable enervating cradle-to-the-grave philosophy, is bringing about, as that same eminent journal concludes, "competition without rewards, wars without victory, statistics without end." It is an alien trend, a very paralysis of initiative, and in the "land of the free and the home of the brave," we want no part of it. But if we are to implement our resolution to be and re-

main free men, we must assume the responsibility for doing those things which otherwise most surely the government will seek to do for us.

Now bear in mind that when the government does something for us in areas which properly are not the province of the government, it is very apt to take two dollars out of our pockets, spend a dollar on red tape and the other dollar not too efficiently in the performance of functions which we could have performed much better for seventy-five cents. It is essential that business management take the lead, both financially and with personal effort, in supporting hospitals, schools, seats of higher learning, community funds, the Red Cross, the Blue Cross, the church, and all of the other institutional aspects of a free society. Furthermore, if we are to realize any sort of a fair return on the billions which the American taxpayer is pouring into Europe and Asia, our international relations in the field of business management cannot be abandoned to a paternalistic government. American business management needs to develop more active contacts with its counterparts in other lands, and should lend its support to organizations like the National Management Council, which seek to carry the voice of American business overseas. The leaders in the work of all of these bodies must be drawn predominantly from the field of management, for the direction of complex enterprise is peculiarly its sphere.

In meeting this challenge, management not only is discharging a moral obligation, it is performing an essential function of its position in society by creating a favorable climate for the success of American commerce and industry. In brief, it not only is morally right; it is good business. Here again management must make it possible by encouragement, example, and support for the younger element in the business enterprise to play its role in these affairs.

One of the first duties of the citizen in a republic is to make his influence felt on the course of legislation and in the selection of public servants. The measure of this obligation is the degree of one's understanding and competence. Each should do his bit according to his lights and his ability. Thus perhaps the greatest indictment of American democracy is the failure of its business management to participate more broadly in politics. I do not imply by this that every man who fails to run for office is shirking his civic duty. Many a good manager makes a poor politician. Though he may aspire to be a statesman, there is grave doubt in my mind as to whether a great statesman must not be first a good politician. But one's obvious shortcomings as a candidate for public office should not deter him from taking an active part in public debate and discussions on political and economic affairs, legislation, and related matters. Those who have the political bent most certainly should exercise it, and there must be thousands of them within the ranks of management. Thousands of others will discover unsuspected talent for political action if they will but address themselves to the pressing problems of the day. The obligation of management to leadership should be asserted where political temperament and competence are present. And let it not be forgotten that tomorrow's senator is cutting his political eyeteeth in today's local ward caucus. The young business executive, possessed of ideals of honest government and public service, should be given the chance to put them into practice. It is good insurance for tomorrow's industrial climate.

Management's obligation to leadership has some negative aspects, too. All too frequently it finds itself the last line of defense against popular but specious economic and quasi-social movements. It is a difficult dilemma, fraught with no little risk of adverse repercussion to management's public relations. But the obligation is great. When our form of government was changed from a republic into a democracy through the direct election of United States senators under the 17th Amendment, the most important check on impulsive and ill-considered legislation was removed. The national House of Representatives was originally created as the direct mouthpiece of the people. It always has been a precipitate and volatile body, but the founding fathers wisely created in the Senate a deliberative chamber to act as its balance wheel. The old Senate, responsible only to the state legislatures, was a deliberative body in the strict sense of the word. It had to be, for it took time for the senators of the old days to consult with the legislative groups back home, which met only periodically. Sudden waves of hysteria under such a system had time to abate and spend themselves before crackpot proposals were reduced to statute. Those days are gone, alas, and our nation, which again I emphasize was not founded as a democracy but with wisdom and foresight as a republic, has surrendered it pristine form. No longer have we, in fact, a House and a Senate in the original sense. We merely possess two peoples' assemblies instead of one, with little or no hindrance to the rash impulse of mass movements. The dangers of adopting unwise legislation under such a system were grave enough in the first instance; in a day when a single demagogue can talk to a hundred million people and even stand before them to grimace and gesture in his own likeness, they are a serious threat to our institutions. It is doubtful if all of the people can be wrong all of the time, and I am quite willing to agree that most of the people are probably right most of the time. Certainly, however, there is abundant evidence that a majority of the people can be wrong some of the time. Mass movements concentrate on objectives with little inclination to consider costs or consequences. Under such circumstances, management's instinctive tendency to weigh proposals in the light of their long-term potentials becomes of vital import to the health of our political economy. Who is better fitted to count the cost and to judge, as to legislative proposals, whether the game is worth the candle? Management has a very great obligation indeed to oppose, and influence others to oppose, all measures which will break down the strength and foundations of a great nation.

It is a hazardous task which faces us. By definition, opposition is a negative process and therefore likely to be unpopular. We all like people who do things better than we like people who are against things. Nevertheless, if we are to avoid the primrose path of socialism, leading straight to the destruction of individual freedom and the sacred privileges embraced within the Bill of Rights, management must stand its ground, as it would within its own business, when the crackpot and the visionary agitate for laws which will abrogate the rights of free men, propose measures which our economy cannot support without danger to its stability. In performing this vital obligation of leadership, we must answer to our consciences. The management which is deterred from taking the long view for reasons of near-term expediency and business gain is selling its birthright for a mess of pottage. Opportunism is one of management's gravest temptations. But the laws, the tariffs, the rules by which the game of business is played, the mass movements supported, and the mob hysteria opposed, synthesize the future pattern of industry, commerce, and finance, the mosaic of our great industrial democracy itself.

How then shall management chart its course? To direct its internal affairs so that business will succeed, to train the managers of the future, to create and defend an economic and social climate in which freedom of enterprise can prosper and to justify before the world by its deeds and accomplishments the existence of such a climate—these are the prime obligations of management to leadership. They are missions for men of high purpose, tireless vigor, creative intellect. God grant that we may fulfill them.

REGISTRATION *by* ENDORSEMENT

By D. B. STEINMAN

CHAIRMAN, NCSBEE COMMITTEE ON REGISTRATION BY ENDORSEMENT

THE one outstanding weakness in registration procedure for professional engineers lies in the unnecessary barriers and hurdles that have been erected against interstate practice. In the early days of registration legislation, the opponents of the movement predicted this difficulty; they feared that registration would become a nuisance and would be abused as a barrier to restrict interstate practice. In defending the proposed legislation, we assured all doubters that the administration of registration would be in the hands of professional engineers of high ideals and that it would be kept sensible, clean, and fair. We promised that everything possible would be done to facilitate the free flow of engineering talent and services from state to state. We must keep faith with the profession and fulfill this promise.

The primary purpose of professional registration is to eliminate the practice of the unqualified. That is the sole justification. Any requirements or obstacles beyond the assurance of professional qualification are a perversion and abuse of registration.

Much progress has been recorded in extending and perfecting registration legislation and in improving registration procedure. The only phase in which progress has not been creditable to the engineering profession is in facilitating interstate practice. The outstanding importance of this phase of registration should be recognized. Freedom of interstate practice, without unnecessary barriers and restrictions, is more important in engineering than in any other profession. Selfish restrictions, provincial attitudes, unreasonable requirements, embarrassing hurdles, exorbitant assessments, and expensive and time-consuming procedures must be eliminated. These have no place in the picture of professional registration.

Summarizing a two-year survey, including questionnaires and correspondence, a tabulation[1] of current requirements in the various states for "Registration by Endorsement Without Written Examinations" is appended to this report. That tabulation is presented with a feeling of keen disappointment. We, who have been entrusted by the profession with the administration of registration, cannot be proud of that showing.

In considering the broad question of interstate registration, three governing principles should be laid down:

1 The sole purpose of registration is to assure professional qualification. If an engineer of established standing and known qualifications applies for Registration by Endorsement, the state board should have full flexibility and discretion to grant Registration by Endorsement without written examinations or other embarrassing requirements.

2 The sole precaution to be taken in granting Registration by Endorsement is to make sure that it is not being used as a back-door route to evade qualification requirements by the expedient of first securing registration in another state of lower qualification requirements.

3 An engineer should not be expected or required, as an evidence of good faith, to secure registration in all of the forty-eight states, in remote anticipation of possible future engagements or of possible future jacking-up of requirements. If he is properly qualified, he should feel reasonably assured of the availability of Registration by Endorsement in other states when and as he may need such registration.

With these three basic guiding principles in mind, a review of the current requirements of the various state boards reveals the following features that call for correction:

1 *Insistence on Reciprocity Agreements.* Insistence on reciprocity agreements is fundamentally wrong in principle. The individual applicant should be judged on his individual qualifications. He should not be penalized for the inability of his home state board to enter into a reciprocal agreement. We have to recognize that different states have reached different levels or standards of qualification requirements, and the state having higher requirements should not be asked to lower them in order to enter into a reciprocity agreement. Petty jealousies, coercion, and retaliation have no place in registration procedure. Each state board should strive to do what is right and fair by the applicant without seeking to coerce another state board into a blanket agreement.

2 *Insistence on Written Examinations.* Written examinations are designed for younger men, fresh out of engineering school or a few years after graduation. So used, they have their place as an impartial check of the applicant's educational preparation and of the applicant's ability to apply that knowledge to practical engineering problems. Once the young man has passed a proper professional written examination in one state, he should not be required to pass written re-examinations in other states. That would make interstate registration an intolerable hardship. For older engineers of established professional standing, twenty or thirty years after graduation, written examinations are out of place. For these older engineers of eminence, their record of work successfully accomplished is a more valuable index of competence than any classroom type of written examination. We may require the younger candidate to show a retained or refreshed knowledge of all the subjects taught in the classroom, but we can forgive the older engineer who has grown rusty in some of the unrelated academic studies through disuse but who has more than made up for it by growth in expert knowledge in his own field of practice and specialization. For such older engineer, a written examination is both a time-consuming nuisance and an embarrassment. Prominent, highly qualified engineers have given up professional engagements in other states rather than subject themselves to the nuisance and embarrassment of a written academic examination at their age. Insistence upon written examinations under such conditions is interpreted as a selfish closed-shop idea for the benefit of local engineers. Such provincialism has no place in the engineering profession.

3 *Insistence on Oral Interviews.* A number of states require endorsement applicants to make a special trip to that state for an oral interview or examination. Some of these states specify that this oral examination must be at a regular formal meeting of the state board. In the case of state boards having infrequent meetings, this may mean as much as a half-year's delay in securing Registration by Endorsement. In any case it means an expensive and time-consuming demand upon the applicant. All of this appears unreasonable and unnecessary. For applicants of questionable qualifications, an oral interview may be indicated as the most effective way of resolving any doubts.

[1] Not included in this printing.—EDITOR.

A report of the Committee on Registration by Endorsement presented at the annual meeting, Daytona Beach, Fla., Nov. 10–12, 1949, of the National Council of State Boards of Engineering Examiners.

For the young engineer who has moved into the state, a board interview is not a serious hardship. But for the busy practicing engineer of established standing and known qualifications, the requirement to travel to a distant state on a specified date for an oral examination is an unnecessary hardship. In probably nine cases out of ten, this requirement can and should be waived. The law should provide for oral examinations in doubtful cases at the discretion of the state board, but should not make oral examinations an inflexible mandate for all applicants.

4 *Misinterpretation of "Grandfather" Registration.* Injustices have been caused by assuming that "grandfather registration" or "registration under a grandfather clause" necessarily consisted of mandatory registration of prior practitioners without examination of qualifications. If any state board interpreted a "grandfather clause" as a mandate to issue blanket registration during the initial period without regard to competence or qualifications, that state board betrayed a professional trust. The applicant's claim that he was practicing "engineering" before the registration law was enacted was in all cases subject to review by the state board before granting registration. Without engineering knowledge and training, the applicant's practice was not "engineering"; and working in a subordinate or subprofessional capacity did not constitute professional "practice." As far as is known, the state boards operating under a "grandfather clause" did not lower their standards to the point of accepting the unqualified and the incompetent. Moreover many of the states never had a "grandfather clause" in their registration laws. It is true that the older state registration laws operated for some years before written examinations were inaugurated. But that does not mean that the earlier registrants under such laws were less qualified. In fact, in such states as New York, registration in the initial years was limited to the most eminent and the most highly qualified. The standards for reviewing and evaluating educational qualifications and professional experience were even higher than in later years. In the later years the educational and experience qualification requirements could be somewhat relaxed since they were supplemented by the written examinations as a final check. Accordingly it is a mistake and an injustice to rate the earlier registrants in such states as "grandfather" registrants merely because they qualified before written examinations were established. It is equally a mistake and an injustice to discriminate against later registrants in the same states who have been exempted from written examinations for the same reasons of superior qualifications and long-established standing. To insist that such older engineers of established superior qualifications take written examinations in other states before securing Registration by Endorsement is contrary to the spirit of professional registration.

In this connection, one important guiding thought is worth stressing. As long as there are exemptions in our registration laws, and as long as there are large groups of qualified men who are under the impression that registration does not apply to them, we must leave the door open for these men to qualify when they become sold on registration. Insistence upon written examinations for these older men would be a serious psychological hazard and would indefinitely retard the universal acceptance and recognition of registration. Registration should not be made a punitive measure. We still have a selling job to do. An arbitrary, inconsiderate, and inflexible attitude alienates and antagonizes. We want to make friends. We want to win increasing support and co-operation for the registration movement.

5 *Misinterpretation of "Equal Treatment."* Some state boards defend their onerous requirements for endorsement registration by declaring that they cannot grant special privileges to nonresidents; if resident applicants are now required to take the written examinations of that board, they argue, then all nonresident applicants must be required to take the same written examinations; and if resident applicants are required to appear before the board for an oral examination, they similarly argue, then nonresident applicants must likewise be required to appear before the board for an oral examination. This type of reasoning overlooks an important distinction. The nonresident applicant for registration by endorsement is not a neophyte seeking his first registration. He has already shown his good faith and he has already established his professional qualifications in his home state and usually in other states. He should not be penalized for not having secured the desired registration by endorsement in the specific state at an earlier date, years before he needed it. Registration would be a burdensome absurdity if every registrant were expected to secure registration in all of the forty-eight states in remote anticipation of future needs and of future jacking-up of requirements. To be strictly fair, an application for endorsement registration should be considered by a state board under the requirements of that board as of the date of the applicant's original registration in his home state, for that was the date at which the applicant established his good faith in securing admission into the engineering profession. Any subsequent or recent jacking-up of requirements applies properly to new registrants, but should not be applied retroactively to those already registered in other states any more than it should be applied retroactively to those already registered in the state under consideration. Moreover, the applicant for registration by endorsement is usually an older engineer of established practice and standing, and in such cases a written examination is hardly a necessary or valid test of professional qualifications and accomplishments. Likewise, appearance before the state board is not a serious hardship for the young local applicant, and a few months' delay in securing registration is not a serious hardship; but for the busy older engineer engaged in interstate practice the requirement of a stated oral interview in another state is usually an unnecessary hardship, expensive and time-consuming, and often interfering with important professional engagements. If the applicant has to wait weeks or months for the stated interview, the commencement of important engineering work may be seriously delayed or the applicant may have to surrender his engagement. Lip service to "equal requirements" results in tragic inequality of hardships. The excuse of "equal treatment" of new local applicants and out-of-state engineers already registered in other states ignores the essential differences between the two categories and violates fundamental requirements of fairness and consideration.

6 *Unreasonable Specifications of Initial Dates of Engineering Practice.* A number of state boards require the applicant for endorsement to show original registration or established practice prior to various fixed specified dates. Some of these specifications are absurd and unfair. Two of the states require an endorsement applicant to show twelve years of practice prior to the enactment of a registration law in his home state! This is clearly discriminatory against those states that were the pioneers in enacting registration laws. An engineer from Wyoming, Louisiana, or Florida, would have to show established practice prior to 1895, 1896, or 1905, respectively, whereas an engineer from North Dakota, New Hampshire, or Montana would merely have to show practice since 1931, 1933, or 1935. In the one case the applicant would be barred unless he showed 54, 53, or 44 years of professional practice, whereas in the other case he would need to show only 18, 16, or 14 years of experience to qualify for registration by endorsement. A Wyoming registered engineer with anything less than 54 years of professional practice would be compelled to

take a written examination in one state, even if he is an engineering graduate, and would be completely barred in another state, no matter how highly qualified he might be, if he did not happen to be a graduate from an accredited school. The discrimination, unfairness, and absurdity of such specifications need no further comment.

7 *Exorbitant Registration Fees.* One state, or rather territory, of the United States denies registration to nonresidents of that territory but will grant a temporary practice permit for a specific project for one year for a nonresident permit fee of $250. A fee of $250 per year or fraction thereof is a high tax on the right of professional practice. Obviously, the exaction or payment of such fee has little to do with the determination of professional qualifications.

In the same vein, we have to deprecate the emphasis on "good standing" in some states, where the phrase is used with the meaning of keeping up the payment of annual renewal fees. Dire consequences are sometimes threatened for any interruption of payment, including threatened lapse of license with future requirement of a written examination for reinstatement. How the payment or nonpayment of renewal fees changes an engineer's competence, it is difficult to see. A registered engineer should not be required to secure a license in another state until he needs it, and after his engagement in that state is finished he should not be subjected to a lifelong tax under threat of future reprisals. The lapsing of a registration in any state in which the engineer no longer needs it should be no reflection on his qualifications. For an engineer paying fees in several states because of past temporary engagements or past expectations of engagements, the continuing cumulative tax (with heavy penalties for oversight or omission) becomes quite a burden. Registration was not established for the benefit of state boards; on the contrary, we conceive the state boards as unselfishly serving the profession and the public. All of the emphasis should be on the qualifications of the registrants. All other considerations must be subordinated or eliminated.

We assured the critics of registration and we promised the profession that registration would never be used as a source of revenue—that it would never be perverted into a racket for the benefit of any group or agency, public or private. We must scrupulously seek to make good on that promise. Professional services should not be subjected to a high interstate tariff for revenue or for exclusion.

RECOMMENDATIONS

All of the objectives and guiding principles of Registration by Endorsement can be accomplished by adopting two simple rules:

1 Waive written and oral examinations if the applicant has passed a reasonably equivalent written examination in another state.

2 Waive written and oral examinations in the case of registered engineers of long-established and recognized standing in the profession.

It is assumed that the applicant meets the statutory requirements in all other respects. If the applicant's standing and qualifications are known, the state board should have full flexibility and discretion to grant Registration by Endorsement promptly upon receipt of the application.

CONCLUSION

The National Council of State Boards of Engineering Examiners has been criticized for the nonuniformity of registration requirements and, in particular, for the unsatisfactory status of interstate registration by endorsement. It is not the fault of the National Council. The National Council has no authority to command and no power to coerce member boards. All we can hope to do is to exert influence in the right direction by education, by precept, and by persuasion. A committee report can be little more than a comparative compilation of procedures, presented for emulation or avoidance as the case may be.

The Committee on Registration by Endorsement has devoted years of effort to this problem. It is a problem of education and persuasion. If this report is strongly worded, that is because it is so important to stir state boards from their complacent adherence to rooted attitudes and procedures. Professional registration is an ideal. To make progress toward the ideal, we must see the weaknesses and the defects that require correction. As member boards of a *National* Council, we must learn to visualize the problem from a *national* viewpoint. We are *one* profession, and we do not want to break it up into forty-eight mutually jealous and exclusive cliques.

Dedicated to the ideal of *one* profession, as envisioned in the highest concepts of the registration movement, this report is submitted "with malice toward none, with charity for all, with courage to do the right as God gives us to see the right."

Aviation as an Instrument of Peace

(Continued from page 228)

minute. We are today facing a real danger in a time of shrinking budgets that this growing obsolescence will be overlooked, that the seed corn of research and development funds intended for airplanes of the future will be consumed. We face the necessity of providing new research facilities and of conducting new and intensive research caused by the development of the jet engine and the attainment of supersonic flight. Unfortunately, the speed of sound cannot be abolished by executive decision. The maintenance of technologic leadership is the only hope of obtaining air power sufficient to serve as an instrument for peace.

Can then an instrument of destruction really be an instrument of peace? The answer is certainly yes, or rather that any instrument, any inanimate creation of man can be either, whether it be automobile, rifle, crowbar, or airplane. The result is determined by the purpose and skill of the user. Let us then look once more at this condition of peace which we all desire, and to whose establishment we should devote all the instruments available to us.

We began with a state of quiet or tranquillity, and since engineers are supposed to be concerned with the world of inanimate Nature, your attention was diverted to a world of physical activity—directed, however, to useful human ends. Had we continued with the dictionary definition, we would have read next, "public quiet, order and security," then the negative concept of peace as "freedom from personal strife and quarrels" and "freedom from international hostilities." We then arrive at "tranquillity of mind or conscience," a positive concept but now referring to man's spiritual environment. I submit that it is this latter kind of peace that the human race seeks and that it is not to be found either in a world which is filled with fears of war, hunger, and pestilence, or in a world of physical and mental inactivity. Rather is it to be found in a society of free men solicitous of the worth of every human being and wishing for each and every one not only the material blessings of adequate housing, food, medical care, and transportation, etc., but also the incentive of mental and spiritual growth and accomplishment. To such a peaceful world, the aeronautical engineer and his fellow engineers can contribute invaluable tools, and can join in using them for the welfare of their fellow men.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Synthetic Mica

SYNTHETIC mica, with essentially the same properties as natural mica, but able to withstand much higher temperatures, has now been crystallized successfully by Dr. Herbert Insley, Alvin Van Valkenburg, and Robert Pike, at the National Bureau of Standards. This work is part of a broad program of fundamental research on fluorine-type artificial minerals carried on by the Bureau under the sponsorship of the Office of Naval Research. The synthetic-mica phase of the program has been carried out in co-operation with the U. S. Bureau of Mines and the Colorado School of Mines.

In the Bureau's work on synthetic mica the requirements of eventual quantity production have always been kept in view. Mica could be synthesized by duplicating the conditions under which it is formed in nature, but this would involve extremely high pressures as well as high temperatures. For safety and convenience it is better to work at atmospheric pressure. For that reason the Bureau's scientists are using fluorine as a crystallizing agent to grow crystals of mica without using high pressure. Natural fluorine is a gas, poisonous and difficult to control, but a group of synthetic fluorine compounds, the fluorosilicates, provides a convenient way of introducing fluorine into mica synthesis.

The raw materials for making synthetic mica are similar to the raw materials sometimes used in making glass: quartz, magnesite, bauxite, and a fluorosilicate compound (the only unusual ingredient). The raw mixture is placed in a platinum-lined crucible and melted in an electric furnace at a temperature of nearly 1400 C. As the furnace cools, mica crystals grow from a tiny seed at the bottom of the crucible.

The most satisfactory synthetic mica developed so far has the chemical formula $K_4Mg_{12}Al_2Si_{12}O_{40}F_8$. This is equivalent to a form of natural mica in which the hydroxyl radical has been replaced by fluorine. Impurities may occur in the synthetic mica in the form of milky films parallel to the individual layers or white patches between crystals. Crystals free of impurities are clear and transparent, and thin flakes are easily split away along the planes of natural cleavage. The synthetic form has physical properties which compare favorably with natural mica. Electrical measurements on several clear flakes, $\frac{3}{4}$ in. sq $\times$ $\frac{1}{32}$ in. thick, indicate a dielectric constant of about 6.3. The largest crystals grown thus far at the Bureau have a surface area of 4 sq in.

The United States is the world's largest consumer of natural mica, but it produces only enough to meet a third of its requirements. During 1948 the United States imported more than 10,000 tons of high-grade mica, mostly from India and Brazil, valued at more than 15 million dollars; in the same period, domestic high-grade production totaled only 135 tons with a value less than 50,000 dollars.

Since the war, world production of natural sheet mica has declined sharply, while production of ground mica has shown a continuing rise to meet the needs of roofing, paint, and rubber industries. The drop in sheet-mica output reflects not only decreasing military demands for high-grade mica but also increasing labor costs which make hand-processing unprofitable. The usable sheet product is only a small fraction of the total processed volume. Some foreign countries can still process natural mica cheaply by hand methods, but producers in the United States are now concentrating on the production of "half-trim" mica.

Successful control of crystal orientation in the growth of synthetic mica would mean that machine methods could be used for large-scale domestic production of sheet mica. In this way mica synthesis could make the United States self-sufficient in high-grade mica insulating materials.

Palletless Materials Handling

IT has often been stated that the large-scale use of pallets in the field of materials handling depends upon the development of cheap expendable pallets. To date, reports indicate, their cost has been too high. Besides cost, however, another limitation is that the small customer is not interested in pallets because he has neither the volume, layout, nor equipment, to justify them.

A partial answer to expendable pallets has been offered by the Yale and Towne Manufacturing Company, through the

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

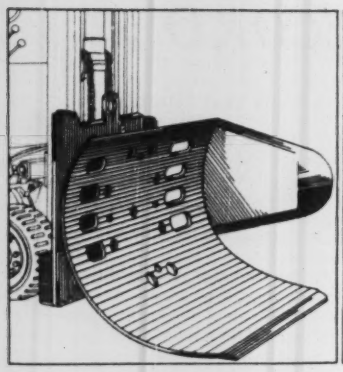


FIG. 1

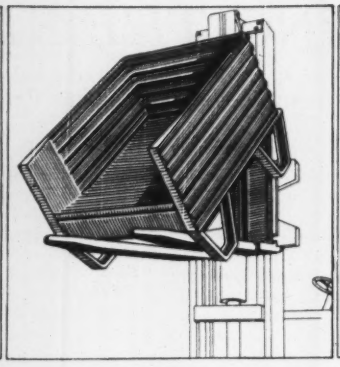


FIG. 2

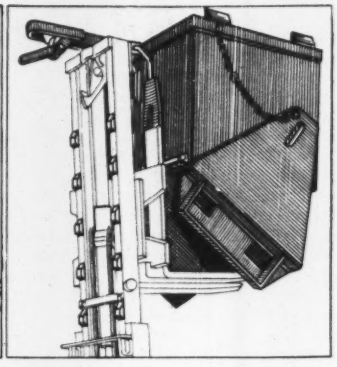


FIG. 3

development of a series of palletless materials-handling attachments. These attachments, some of which were recently shown and described at a Yale materials-handling demonstration in New York, N. Y., are all interchangeable, and should provide all types of industry with modern materials-handling improvements which can be put profitably to work.

Brief descriptions of the attachments shown in the accompanying illustrations follow:

Fig. 1 shows a hydraulically operated roll-handling attachment which revolves 90 deg to up-end rolls of paper, linoleum, cloth, rubber, roofing material, and other rolled materials. The mast of the truck tilts back, cradling the load when picked up horizontally, thus preventing it from rolling off the attachment. The truck can stack rolls endwise or in horizontal tiers.

An end dump hopper for handling hot castings, steel scrap, forgings, machined parts, and the like, is illustrated in Fig. 2. It requires no extra motive connections. A hook is secured to the mast of the truck and this hook, when engaged, holds the back bottom edge of the bin in place so when the forks are lowered the front end of the bin drops downward and the bin spills its load. The level of discharge is regulated by the mast elevation when dumping.

The bottom dumping hopper, Fig. 3, is similar to the hopper in Fig. 2 but differs in that a hook suspends this bin from the top, and when the forks lower, the bottom of the bin hinges downward to release the load. Because it is totally enclosed and can carry a full load, this hopper is well adapted for handling sand, lime, stone, etc.

The attachment shown in Fig. 4 was developed primarily to handle tin plate, but is now also used for other sheets of material which have a tendency to slide during transport. When lifting, the forks float downward about two inches pulling the two iron "hands" down on the load, holding it firmly in place. The hands can be adjusted to accommodate stacks of varying height.

A hydraulically operated clamp, which opens to 72 in., is shown in Fig. 5. This device is particularly suited to handle large-size units such as bales of cotton, large crates, cardboard containers, drums, and boxes.

Boxes, barrels, bales, drums, and cartons can be handled in multiple units with the hydraulically operated pallet unloader and pusher, Fig. 6. Hydraulic cylinders unfold the pushing device which shoves loads off the forks. Pallets are not required when handling large loads which straddle both forks. Pallets can be eliminated when handling smaller loads by placing a metal plate over the forks and stacking the goods on this plate. As the pusher is extended, the truck moves backward, a locking device holding the plate on the forks. Thus manual handling for loading railway freight cars, for example, is eliminated.

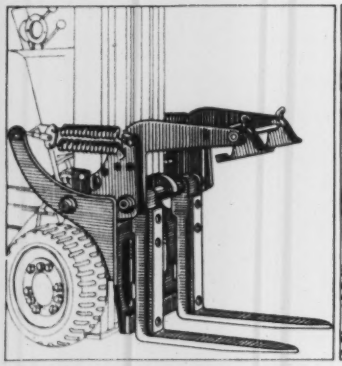


FIG. 4

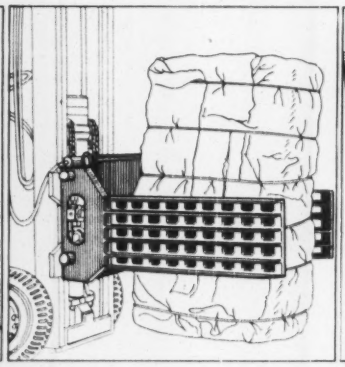


FIG. 5

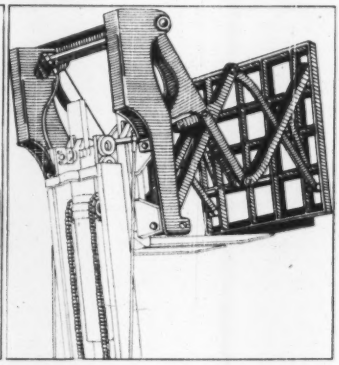


FIG. 6

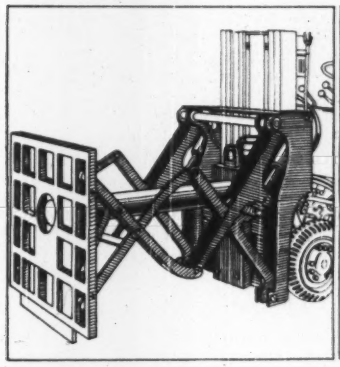


FIG. 7

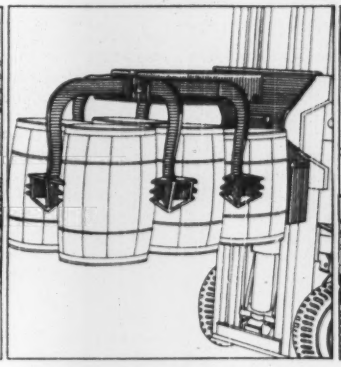


FIG. 8

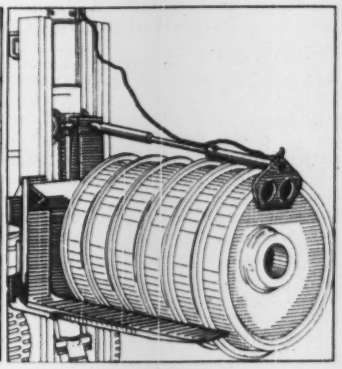


FIG. 9

The hydraulically operated pusher, Fig. 7, is similar to the one in Fig. 6, the difference being that the pusher in Fig. 7, is equipped with a ram for pushing off coils of steel, wire, pipe, etc.

A multiple-keg-handling attachment is shown in use in Fig. 8. Hydraulically operated, this device can handle kegs, small drums, and cylindrical cardboard containers. This handler is particularly advantageous when loading and unloading freight cars and street trucks because containers do not have to be manually placed on or taken off pallets or skids for handling.

Fig. 9 shows a simple device for handling disk-shaped objects such as railroad-car wheels. It is a hoelike attachment hinged to the mast of the fork truck. The operator engages and disengages the "hoe" by means of a wire attached to the hoe and looped over the top of the mast.

The hydraulically operated shovel scoop, depicted in Fig. 10, is adapted to handle loose free-flowing materials such as coal, gravel, sand, loose chemical batching ingredients, etc. It holds up to 27 cu ft and rotates upward to hold the load during transport. Dumping can be accomplished from any height on the mast.

The multiple-fork attachment, Fig. 11, was designed specifically for handling concrete blocks, rough shell, pipe, etc. Individual forks can be lifted manually a few inches for alignment with each of several blocks which make a load (that is why two of the forks appear staggered). Actually, when lifting the load, all forks are on the same level.

Fig. 12 shows the "load-hugger," which handles either flat-sided or cylindrically shaped loads, such as bales of fabric, large crates, pigs, and drums. The forks grasp the load in a pincherlike movement.

Besides the foregoing devices, other devices developed by Yale include a gooseneck boom for carrying bulky loads or odd-shaped loads that cannot be easily handled on forks; an attachment (removable fork extensions) for handling extra-long loads; a load backrest for supporting extra-high or wide loads; a hydraulically operated clamping revolving paper roll handling device; a hydraulically operated double-drum handling attachment; a multiple-drum carrier hydraulically operated, which carries four drums without the use of pallets; a hydraulically operated rotating carriage for pouring liquids (molten metal) or dumping bins; and a hydraulically operated side-shifter attachment for positioning loads close to walls and pillars and in confined areas such as freight cars and truck trailers.

All of these attachments are quickly interchangeable and can be used on Yale and Towne battery-powered and gasoline-powered hydraulically equipped fork trucks. They can also be used on Yale's battery-powered hydraulically equipped "walkie" trucks.

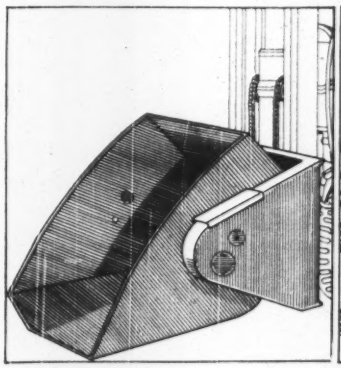


FIG. 10

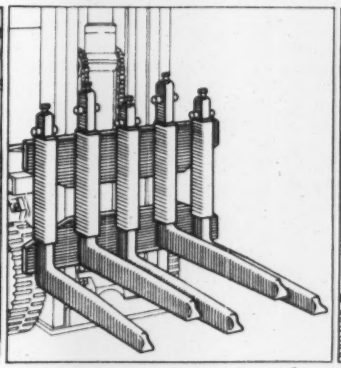


FIG. 11

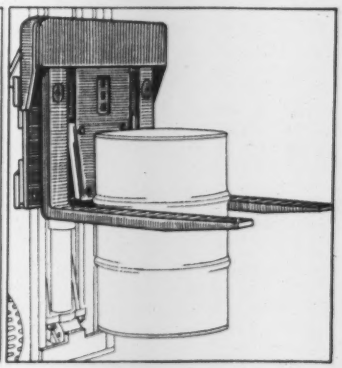


FIG. 12

Iron-Ore Discovery

DISCOVERY in Venezuela by the U. S. Steel Corporation of what is claimed to be the largest and richest iron-ore deposit in the history of the world, is described by T. W. Lippert, manager of publications, AIME, in the February, 1950, issue of *Mining Engineering*. This rich lode of iron ore first attracted the interest of Corporation geologists in April, 1947, when they aerially photographed the area south of the Orinoco River and west of the Caroni, a tributary of the Orinoco. This new mountain of ore, Cerro Bolivar, juts starkly upward 2000 ft from a great surrounding area of flat savanna grasslands. The mountain is visible for a great distance; it appears on many maps, and it is 50 miles from the well-known ore holdings of M. A. Hanna Company and Bethlehem Steel Company at El Pao, east of the Caroni.

Diamond-drill holes in Cerro Bolivar show iron ore of almost theoretical maximum purity all the way down for 148 ft. Ore will be quarried from the top of Cerro Bolivar and dropped on to a 4-ft conveyer belt some 2 miles long, which will carry the ore from the 2900-ft level down to railroad cars at a 1600-ft level. The belt will generate enough electric current for the new townsite and all the area operating facilities.

According to the article, the discovery of Cerro Bolivar was the terminal point of a quiet but record-breaking search for foreign ore around the entire periphery of the North and South Atlantic Oceans, covering some 5 yr and involving thousands of men inspecting deposits in the entire Caribbean area, South and Central America, Africa, Canada, Alaska, and Sweden.

The U. S. Steel Corporation has kept the magnitude of its find secret in order to verify its world-record magnetometer readings by means of extensive diamond drilling. More than one billion tons of iron ore of practically maximum theoretical purity have already been uncovered. U. S. Steel has obtained 18 denouncements of 100 yr duration in the Cerro Bolivar area, and six concessions of 40 yr duration in the La Grulla area, east of the Caroni.

A former M. A. Hanna geologist, Mack C. Lake, made the discovery for U. S. Steel and has now been made first president of the subsidiary organization, Orinoco Mining Company. Plans are being rushed forward to open up the Cerro Bolivar area to speed ocean shipment of ore into Birmingham, Ala., Baltimore, Md., and Trenton, N. J. It is planned to mine 10 million tons annually by late 1953; later, at least 15 million tons annually. Total investment cost by U. S. Steel in Venezuela, including giant ocean ore carriers, will approximate $400 million. A decision will soon be made as to whether the ore will be brought out of Venezuela via the Orinoco River. If so, dredging of 46 million cu yd of river bottom will be required to open a channel 170 miles upstream to a rail loading terminal at the confluence of the Orinoco and Caroni Rivers, some 91 miles by railroad from Cerro Bolivar. The other option is a 274-mile, $100 million railroad across country from Cerro Bolivar to deep tidewater at Puerto de la Cruz, near Barcelona, which will require a $4\frac{1}{2}$-mile bridge across the Orinoco near the town of Ciudad Bolivar and will pass through active oil and gas fields.

For the ocean hauls plans are under way for the construction of giant ocean ore carriers, probably 45,000 tons. The largest of Great Lakes ore carriers haul 18,000 tons. The first 2 million annual tons of Venezuelan ore will go into Birmingham, where the richer ore will immediately raise production by 15 per cent with the same physical equipment. Many millions of tons will come from Baltimore into the Pittsburgh and Youngstown districts. Adequate bulk unloading facilities are already in existence at Baltimore.

The discovery of this deposit of iron ore in Venezuela and the plans going forward for its development will have a profound influence on the American steel industry and the entire American economy, Mr. Lippert states. It is expected that the Venezuelan ore will arrive in the Pittsburgh and Youngstown areas at a lower unit cost than the Lake Superior natural ores. The Venezuelan ores likewise are expected to show a lower unit cost in the Pittsburgh area than any future deliveries from Labrador or beneficiated low-grade ores from Lake Superior. The Corporation, as usual, will sell iron ore to all other steel companies which may wish to buy.

The availability of Venezuelan ore comes at an opportune time, just when the serious depletion of natural ores in the Lake Superior region is forcing the entire steel industry into a tremendous capital expenditure to develop concentration plants to grind and separate the low-grade taconite ores in the Superior region.

According to *Mining Engineering*, the Lake Superior direct-shipping ores face exhaustion between 1965 and 1970 at present rate of consumption. If a minimum of military reserve of open pit ore is to be maintained, the current development of low-grade ore must accelerate greatly. This will demand tremendous capital expenditures.

By mid-1960 it is expected that steel companies, other than U. S. Steel and Bethlehem, will be basing their production on 10 million tons of ore annually from Labrador, 17 million tons of taconite concentrates, $\frac{1}{2}$ million tons from Liberia; and will be buying about 4 million tons of Venezuelan ore. This will involve new investment of well over $600 million, exclusive of the lake vessels required for Labrador ore.

By mid-1960 U. S. Steel's ore balance sheet will show 15 million tons annually from Venezuela and 10 million tons of beneficiated Lake Superior taconites. U. S. Steel definitely plans to have $\frac{1}{2}$ million tons of taconite capacity in operation by 1952. All this will cost the Corporation some $600 million, not including the cost of an eastern seaboard steel plant.

Between now and 1965 American steel companies must invest more than $1.2 billion in taconite plants and foreign ore sources to take the place of the rapidly disappearing Superior natural ores. This sum is in addition to usual year-to-year capital expenditures. Some of this added cost will of necessity reflect back into the market price for finished steel, but the price rise which might have been as much as $4 a ton, if beneficiated taconites carried the entire burden, will be greatly modified because of the ore strike in Venezuela.

High-Speed Photolight

ENGINEERS are now photographing missiles moving many times faster than sound and even making pictures of sound waves themselves, William R. Plant, a General Electric Company engineer, said recently before a meeting of the American Institute of Electrical Engineers in St. Louis, Mo. Mr Plant described methods for making pictures with exposures of a few millionths of a second. He also said that techniques have been devised for making sound waves visible as they pass through air. Such pictures are proving invaluable in research into the behavior of missiles in flight and wind-tunnel models of faster-than-sound aircraft.

He said that high-speed photography is often the only way to gather information on action thousands of times quicker than the eye can follow.

The fastest camera shutters can cut exposure time down only to about one thousandth of a second, which is long enough for an army rifle bullet to travel almost two feet. Hence exposures in the millionth-of-a-second range must be made with quick flashes of light rather than by means of fast shutters.

Mr. Plant described a special photolight, designed in the G-E

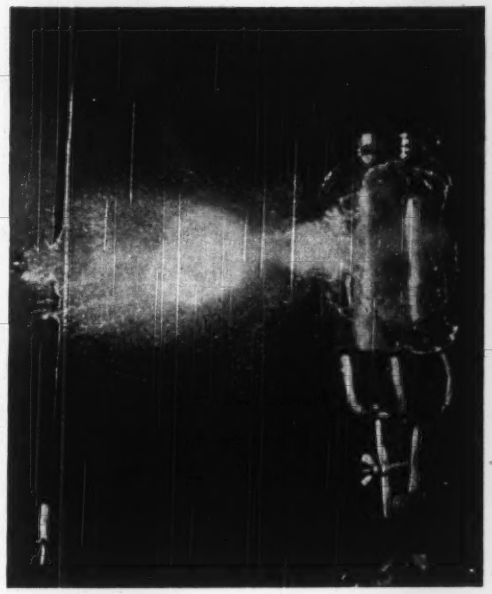


FIG. 13 HIGH-SPEED PHOTOLIGHT

(A 0.22-caliber bullet smashed through a glass jar, then broke an electrical conductor to take this picture. Breaking of the conductor set off a high-speed photolight, which illuminated the action for two-millionths of a second.)

General Engineering and Consulting Laboratory, Schenectady, N. Y., which gives a brilliant flash of light lasting only two-millionths of a second. He showed pictures of bullets and shells in flight which were taken with an ordinary camera and the high-speed photolight.

Photographing sound waves, which move at about 760 mph, require a high-speed flash and a special optical system, which can cast into sharp relief varying densities of air. This method is known as "schlieren technique," and produces photographic images of sound waves, which are areas of high compression in air.

Coal to Gasoline

THE Coal Hydrogenation Demonstration Plant at Louisiana, Mo., has completed a continuous 7-week "break-in" run, converting coal-tar oil and Wyoming coal to gasoline and other liquid fuels, it was announced by Oscar L. Chapman, Secretary of the Interior.

This operation is deemed of particular interest, Secretary Chapman said, because it is the first time that substantial quantities of oil have been made from tar oil and coal by hydrogenation in this country. The basic plant design proved to be sound and operable, he said. With minor changes and adjustments, the plant will be a useful tool in the development and study of the processes for the conversion of coal to liquid fuel. It is contemplated that a wide variety of other coals will be tested later.

The demonstration plant was designed to produce 200 to 300 barrels of liquid fuels daily from coal in the two high-pressure steps with pressure release and fractionation of the products between stages and at the end of the second step. In the first stage, called the liquid-phase hydrogenation, a paste of pulverized coal and heavy oil is converted by the addition of hydrogen to mainly a synthetic crude oil. In the second step, or vapor-phase hydrogenation, this crude is hydrogenated further to produce high-grade synthetic gasoline and other fuel-oil fractions. The plant utilizes American-made equipment throughout.

The vapor-phase plant was operated last April to hydrogenate lignite coal-tar distillate to gasoline and Diesel fuel. However, the current liquid-phase run was the first during which coal tar and coal-paste feed stocks were converted to synthetic oils. The operations were carried out at a pressure of 10,000 psi and a temperature of 850 F, producing gasoline, naphtha, and vapor-phase charging stock.

After a thorough pressure-testing period, inert nitrogen and later hydrogen were circulated through the system to break in moving machinery and test the instrumentation. The actual break-in operation started with the introduction of high-temperature coal-tar oil on October 12. The charging stock and hydrogen first were circulated at full pressure and reduced temperatures, then the temperature was gradually raised to the reaction level. The tar-oil hydrogenation was conducted at 850 F and after the available stock was used up, a paste containing 25 per cent Wyoming bituminous coal was introduced The run continued in a very satisfactory manner and was terminated with a planned shutdown on December 2. Detailed operational and production data are available but are not considered representative as the purpose of the run was exploratory.

For a description of the plant see "Coal Hydrogenation," by J. A. Markovits in the July, 1949, issue of MECHANICAL ENGINEERING, pages 553 to 560.

Mercury Steam Station

THE first installation of a mercury-unit power station designed and constructed as a complete power-generating unit was placed in service at Portsmouth, N. H., on January 18, by the Public Service Company of New Hampshire. Built by the General Electric Company, this new station, having a rated capacity of 40,000 kw, is expected to be one of the most efficient fuel-burning plants of its size in the world.

Named the Schiller Station, in honor of Avery R. Schiller, president of Public Service, the new plant consists of two standard design 7500-kw mercury-turbine generators, two mercury-boiler furnaces, two heat-exchange units called condenser boilers, and a 25,000-kw steam-turbine generator.

The decision to build a fuel-burning plant employing the mercury-steam or binary cycle was influenced by the unreliability of water power and the extremely high costs of fuel in the New Hampshire area.

By its very nature, a binary cycle is more expensive to construct but it will produce a given amount of electricity from about three fourths of the fuel needed in a conventional steam plant.

In operation, heat from the burning fuel is absorbed by liquid mercury within the tubes of the mercury boiler to form mercury vapor, which passes from the boiler to the mercury turbine, where the vapor releases a portion of its energy to produce electric power. The vapor from the turbine is exhausted to the vacuum shell of the mercury-condenser boiler. There it condenses and releases its heat of vaporization to water within the tubes. The liquid mercury is returned from the sump, or hot well, to the boiler by a mercury feed pump.

The water in the condenser boiler which absorbs the heat

from the exhaust mercury vapor may be boiled into steam at any desired pressure. The steam so derived, after being superheated by recirculation through the tubes located in the gas passages of the mercury boiler, drives the 25,000-kw steam-turbine generator. In effect, the condenser boiler which condenses the mercury vapor and boils the water is an evaporator which makes possible the use of water of poorer quality than could be tolerated in a conventional steam cycle.

The Schiller Station can operate with either Bunker "C" fuel oil or pulverized bituminous coal. Both types of fuel-burning equipment are of standard design with the exception that a set of low-load fuel-oil burners have been provided for each mercury boiler to satisfy expected station minimum-load conditions.

When the plant is operating on fuel oil, as it does presently, the fuel oil flows by gravity from the main storage tanks into a 3000-gal station storage tank.

The fuel oil is then pumped from this storage tank through the fuel-oil heating system, metered, and finally burned in the mercury-boiler furnace.

To operate the plant with pulverized coal, when desired, crushed coal from the storage yard may be brought into the station by means of an inclined-belt coal conveyer which distributes the coal to a 1000-ton coal bunker mounted in a coal-preparation bay in front of the two mercury boilers.

The coal flows downward from the coal bunker through suitable pipes; it is weighed and then pulverized before entering the furnaces where combustion occurs.

The fly ash produced from the burning coal will be caught by the fly-ash precipitation equipment and removed from the station by means of a pneumatic ash-removal system.

The electrical control room is elevated above the turbine-room floor so that the control-room operator may have a complete view of the main operating floor.

Actual control and operation of the mechanical equipment is from a centrally located supervisory control room on the main operating floor. Practically all of the station auxiliary equipment is started or stopped by suitable control switches from the supervisory control room, while the three main turbine sets must be manually started by a hand control on each unit.

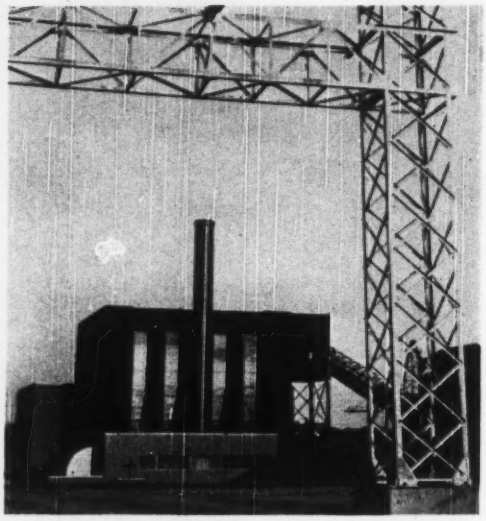


FIG. 15 EXTERIOR VIEW OF SCHILLER STATION

When the main equipment is once in operation and "on line," the complete control and loading of the units is by either manual control or full-automatic control from the supervisory control room.

Unlike the usual steam-generating station, when the plant is operated at base load, the two mercury turbines operate with their control and stop valves in the wide-open position, thereby receiving their mercury vapor directly from the vapor drums of the mercury boilers. The electrical output from the mercury-turbine generator is therefore a direct function of the rate of vapor generated by the fuel supplied to the mercury-

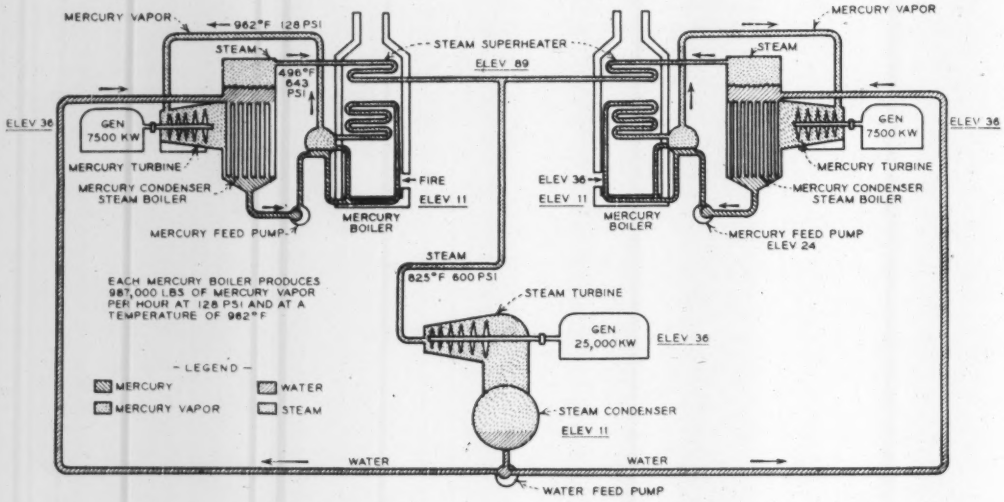


FIG. 14 SCHEMATIC DIAGRAM OF MERCURY-STEAM CYCLE USED IN NEW SCHILLER STATION

boiler fuel burners. The greater the electrical load demand, the greater the direct fuel requirements.

The effect of such an operating procedure upon the output of the 25,000-kw steam-turbine generator is quite definite and positive, as the steam produced by the rejected heat of the mercury turbines' exhaust must be utilized by the steam-turbine generator to produce some 60 per cent of the total electrical output of the station. Therefore, like the two mercury-turbine sets, the electrical output of the steam unit, and subsequently the entire station, is really a direct function of the rate of fuel burned in the mercury boilers. An increase or decrease in the load demands upon the station must be satisfied by the quantity of fuel burned.

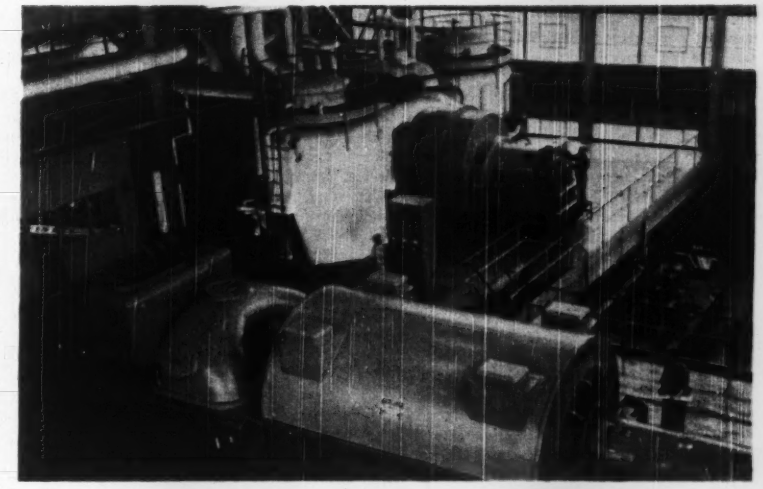


FIG. 16 TURBINE ROOM AT NEW SCHILLER STATION
(In foreground is 25,000-kw steam-turbine generator. To the rear is one of the station's two 7500-kw mercury-turbine generators.)

The station may be operated, if desired, to control the system frequency by proper manipulation of the steam- and mercury-turbine speed governors. At the present time the station is operating as a base-load unit, thereby utilizing this highly efficient power plant to produce the maximum amount of 9200 Btu per net kw for use by the system.

The electrical energy thus produced is generated at 13,800-volt, 3-phase, 60-cycle, and the output of the three generators is paralleled on the 13,800-volt bus from which outgoing feeders are run to the step-up power transformers located in the outdoor substation.

Power for operating the station auxiliaries is taken from the main bus through two transformers which supply two groups of 2300-volt auxiliary switchgear. Connected to each one of these groups is a load-center substation for the 460-volt services.

Automatic equipment is used extensively for transferring auxiliary supply sources and bringing reserve auxiliaries into operation. An extensive annunciator system informs the control-room operators of the occurrence of abnormal conditions in the operation of the station while an automatic telephone system and separate loud-speaker paging system provide communication throughout the plant.

The plant heat balance was set up on two bases, one when the plant is burning Bunker "C" fuel oil and the second when the plant is operating with pulverized Eastern bituminous coal. The station gross generation is expected to be the same when operating with either coal or oil as the fuel, although the final net send-out per hour from the plant will be slightly less with coal firing due to the additional power requirements of the coal preparation and certain other auxiliary equipment. The station net heat is lower when burning fuel oil because of lower auxiliary power requirements and higher boiler efficiency. When operating at design rating, the plant net heat rate when burning Bunker "C" was expected to be 9200 Btu per net kwhr and 9420 Btu per kwhr when burning coal.

Cost of the plant and its associated substation and transmission-line connections will be approximately $13,000,000. While this may appear high for a 40,000-kw plant, it was pointed out that much of the money spent for land, dockage, fuel handling, fuel storage, condensing water, and the like, will be adequate for a plant at least four times the size of this first unit.

The output from Schiller Station will combine with the output from the company's six other fuel-burning plants and 31 hydroelectric plants to supply the utility's 117,000 customers in about 70 per cent of New Hampshire, together with other New Hampshire electric companies and co-operatives which are normally supplied with power by Public Service. Schiller Station will make a considerable addition to the total of New England's electric-generating capacity, which is now being greatly expanded to meet the ever-increasing needs in homes, farms, and industries.

Wind Tunnels

Subsonic Tunnel

A NEW wind tunnel opened recently at the University of Maryland, according to the *Pegasus*, November, 1949, promises to be one of the key instruments in deciding the shape of things to come in aeronautical and allied fields.

The newest of its kind in the country and perhaps the best in eastern United States, the tunnel began operations last July.

Most of its current work is military and much of it top secret, but provisions are being made for testing civilian equipment.

The Maryland tunnel is a medium-speed subsonic type, with a top wind velocity of 350 mph. Tunnel propeller is 19 ft in diam, with seven blades. It is powered by a 1750-hp electric motor, which spins the blades at a rate of 600 to 700 fps—a top tip speed of 400 mph.

An elaborate electrical control system for the motor maintains the speed of rotation within one quarter of one per cent of any desired value up to a maximum of 850 rpm.

Test section of the tunnel includes a shell of reinforced concrete with smooth walls hand-finished on the inside to offer a

minimum of flow resistance. The section is 7 × 9 ft high × 11 ft wide, permitting model wing spans of 8 or 9 ft. Large panels of bulletproof glass and recessed lights provide excellent visibility.

While student talent will have opportunity to study models under test in the artificial big wind, officials are proceeding with great care in setting up the training program which will be one of the tunnel's outstanding uses. Models used can cost from $10,000 to as much as $500,000 each and careless handling in the tunnel could result disastrously. Too much wind may tear the model apart and scraps hitting the tunnel prop could do tens of thousands of dollars worth of damage. A loose model caught in the tunnel is a lost model.

Staff, students, and graduate students are therefore being trained with great care. It is planned to have as many as six graduate students working on projects toward their masters or doctorate degrees. Meantime, the tunnel's present staff of ten operates the tunnel.

3000-Mph Tunnel

The largest wind tunnel at any university for research on problems of high-speed flight was dedicated recently, marking completion of the Naval Supersonic Laboratory at the Massachusetts Institute of Technology, Cambridge, Mass.

Constructed under the auspices of the Navy Bureau of Ordnance, the wind tunnel was operated successfully at a speed twice that of sound. The tunnel is designed to provide speeds ranging from 1.2 to 4 times that of sound—up to 3000 mph.

The Naval Supersonic Laboratory, including building, wind tunnel, and associated instruments, represents a capital investment of $2,600,000. It marks a substantial increase in the laboratory facilities of the Institute, and will be devoted to both fundamental research and education.

The Laboratory will be used for testing scale models of supersonic missiles and components and for research to obtain basic aeroballistic information. Results of the research completed in this wind tunnel, it was reported, should make possible improvements in high-speed missiles and aircraft of both piloted and automatically guided types. An extensive training program for advanced students at the Institute will be undertaken in conjunction with the laboratory's research.

The test section of the new wind tunnel, where models are studied in the high-speed air stream created by the machine, measures 3 sq ft (18 × 24 in.). By changing the density of the air passing through the test section, conditions of guided missile and airplane flight at high altitudes can be duplicated.

The wind tunnel is capable of sustained high-speed operation and is therefore suitable for the study of problems which require equilibrium conditions, it was pointed out.

The wind tunnel is a huge closed steel channel, through which dry air is circulated by two large centrifugal compressors driven by electric motors of 10,000 total horsepower. The four-stage compressors have been adapted especially for this application to a supersonic wind tunnel.

The electric power required to operate the wind tunnel represents a large fraction of the generating capacity of the Cambridge Electric Light Company. Heat generated by the compressors is removed by two large coolers which use water from the nearby Charles River as the cooling medium. Approximately 3000 gpm of water are needed to cool the various machines within the laboratory.

Supersonic speeds can be achieved only by shaping the wind-tunnel walls in the vicinity of the test section in a certain specified manner and special nozzles having the proper contours are required. Different nozzles are used for different speeds of operation.

Air temperatures within the test section of the wind tunnel are quite low. At speeds twice that of sound, the temperature is 140 F below zero; at speeds four times that of sound, 335 F below zero.

Instrumentation available for use with the wind tunnel includes a balance to measure the air reaction on the models and an optical system to show visually the shock waves and flow patterns which surround models in the supersonic air stream.

Vacuum-Fusion Apparatus

IMPURITIES in metals can be detected even when the percentage of a given element is as small as 10^{-6} (0.00001) per cent or one part in a million, with the vacuum-fusion apparatus in use at the National Research Corporation, Cambridge, Mass.

This equipment was designed and assembled by the company's research division as a tool for use in analyzing for minute impurities contained in highly purified metals. Ordinary analytical procedures for the determination of the elements in question are impracticable in the percentage range encountered.

The principle is as follows: Under proper melting conditions, high-vacuum metals may be made to give up their gases quantitatively. The combined oxides react with the graphite crucible in which the melting is conducted, and the oxygen is released in the form of carbon monoxide. The hydrides and nitrides are decomposed, and the hydrogen and nitrogen liberated directly. The choice of a correct temperature is highly important. It must be sufficiently high to decompose the chemical compounds and at the same time not so high that the metal being analyzed will volatilize and coat the inside of the apparatus. Sometimes it is necessary to add a flux to assist in achieving these results. The mixture of hydrogen, nitrogen, and carbon monoxide is pumped by means of a mercury-diffusion pump into a vacuum chamber of known volume. The pressure of gas collected is measured by a McLeod gage which is a device intended to measure low gas pressures.

Since the total pressure is low, Daltons law holds. The total pressure P_T of the gases present is equal to the sum of the pressures which each gas would exert if it alone were present in the given volume.

After the total pressure of the gases is determined they are circulated through a tube containing copper oxide. Here the hydrogen and carbon monoxide take oxygen from the copper oxide and are converted to water vapor and carbon dioxide, respectively. All the gases are allowed to circulate also through a cold trap cooled to —196 C by liquid nitrogen. Here the carbon dioxide and water vapor are frozen out while the nitrogen remains gaseous. The nitrogen is then returned to the McLeod gage where its pressure is determined.

The cold trap is then warmed up to about —80 C with a mixture of dry ice and acetone. At this temperature the CO_2 is set free and its pressure plus the pressure of the nitrogen is measured. Knowing the pressure of the nitrogen and the pressure of the gases, all the necessary data for computation of the weight of each gas present can be obtained. Since the volume in which the gas is compressed is known, the number of molecules of each gas or the weight, can be estimated.

The apparatus itself is constructed entirely of glass and the few ground-glass joints present are carefully sealed with a special high-vacuum wax having an exceedingly low vapor pressure. Since the pressure in the system should be in the order of 0.01 micron, the smallest leak will vitiate the results.

The main system is evacuated by the combination of a diffusion pump and a high-efficiency mechanical pump. The

gases are circulated through the system by means of two small high-speed diffusion pumps.

Since it would be impracticable to place a heater inside a high-vacuum system, the metals are heated from outside the system by means of a high-frequency induction coil.

The time for a single analysis exclusive of the preparation of the sample is about an hour and a half. Accuracy depends a good deal on the individual system and the operator, but with care determinations may be made with a high degree of reproducibility. The quantities detectable may be as low as 10^{-6} per cent, as is the case with hydrogen in many metals.

150-Ton Pressure Vessel

A 150-TON pressure vessel, built by The Babcock & Wilcox Company for the testing of underwater equipment at the Naval Ordnance Laboratory, White Oak, Md., and now installed there, will simulate ocean-water pressures down to a depth of half a mile below the surface, it is reported.

The vessel is a heavy horizontal cylindrical shell of steel plate, with one end sealed permanently and the other closed by a hydraulically operated door. Three 7-in. ports of heavy glass along the sides of the shell allow observation of the interior during testing.

Certain underwater apparatus and instruments which are exposed to high pressure and other submarine equipment such as divers' suits, can be tested in the vessel.

Underneath the vessel is a transfer tank in which water is stored while not needed for testing. After the vessel is filled with water, additional water is pumped in to raise the pressure, or water is relieved to lower it. At the conclusion of the test, the water is drained back into the transfer tank, the door is opened, and the object under test is removed.

The vessel is 36 ft long and has an inside diameter of 8 ft with walls 4 in. thick. Its total internal volume is 1994 cu ft. It takes 61 tons of water to fill the vessel which will withstand a pressure of 1000 psi.

The shell consists of three courses, a shell head and a shell ring, each joined to its neighbor by a girth weld. Rolled plate of 70,000 psi tensile strength, per ASME Spec. SA-212, Gr. B, was used in this fabrication. The castings were unusually large; each weighed around 35 tons in the rough. The shell courses were rolled from this 4-in-thick steel plate, the edges of which were pressed hot to obtain the desired curvature. They were then preheated and welded longitudinally. The shell head was hot-formed from one plate by spinning to an elliptical shape. Then the girth welding grooves were machined. The shell courses, head, and shell ring were lined into position on drum turners and rotated slowly under automatic arcs to make the girth welds. The entire shell was held at preheat temperatures to prevent cracking.

All welds were x-ray-inspected, the vessel stress-relieved, and the shell statically tested at 2000 psi without damage, it was reported.

The huge quick-opening door, forming the end of the shell, is operated by simple push-button control. Raised or lowered by oil pressure, the door provides an opening of the full 8-ft diam.

Sealing is accomplished by synthetic-rubber gaskets embedded in the face of the shell.

Rapid but controlled changes in pressure are obtained by first filling the vessel completely with water, then pumping in additional water to raise the pressure, or relieving water from the vessel to lower the pressure. Due to the compressibility of the water and the elasticity of the vessel, an additional 10 cu ft of water are required to raise the pressure to 1000 psi.

Nuclear-Energy Series

THE U. S. Atomic Energy Commission announced that nine volumes totaling 5428 pages of the National Nuclear Energy Series—a comprehensive record of the nonsecret scientific achievements of the wartime and postwar atomic-energy programs, have been published to date, and two additional volumes will be available shortly.

The National Nuclear Energy Series, which has been described as the largest single venture in photo-offset publication of scientific texts ever undertaken, is being published by the McGraw Hill Book Company under a contract with Columbia University, which represents the AEC and its research contractors.

The NNES material, which may run to about 50 or more unclassified volumes, describes work in physics, chemistry, metallurgy, engineering, biology, medicine, and many other fields related to atomic energy. The volumes are being written and edited for the most part by the specialists who performed the original research. The first volume was published in December, 1948.

The work of preparing the NNES manuscripts for printing is performed by the AEC Technical Information Branch at Oak Ridge, Tenn. The Branch also prepares drawings, diagrams, and other illustrative material. The volumes are lithoprinted by Edwards Brothers of Ann Arbor, Mich., and sold by McGraw-Hill.

The nine volumes published to date are as follows:

"Histopathology of Irradiation From External and Internal Sources," edited by William Bloom, M.D.; "Pharmacology and Toxicology of Uranium Compounds," edited by Carl Voegtlin and Harold C. Hodge; "Engineering Developments in the Gaseous Diffusion Process," edited by Manson Benedict and Clarke Williams; "Spectroscopic Properties of Uranium Compounds," by G. H. Dieke and A. B. F. Duncan; "Bibliography of Research on Heavy Hydrogen Compounds," compiled by Alice H. Kimball, edited by Harold C. Urey and Isadore Kirschenbaum; "Ionization Chambers and Counters: Experimental Techniques," by Bruno Rossi and Hans Staub; "Electronics: Experimental Techniques," by W. C. Elmore and Matthew L. Sands; "The Transuranium Elements Research Papers," edited by Glenn T. Seaborg, Joseph J. Katz, and W. M. Manning; and "The Characteristics of Electrical Discharges in Magnetic Fields," edited by A. Guthrie and R. K. Wakerling.

The two volumes scheduled for publication are "Vacuum Equipment and Techniques," edited by A. Guthrie and R. K. Wakerling, and "The Chemistry and Metallurgy of Miscellaneous Materials. Thermodynamics," edited by Laurence L. Quill.

Canadian Hydro

DURING 1949, the postwar boom in hydroelectric construction in Canada continued without abatement. This was revealed in the 1949 results of a regular annual survey covering the field of current water-power development which is conducted by the Dominion Water and Power Bureau, Department of Mines and Resources, with the co-operation of provincial authorities and other power-producing and distributing organizations located throughout Canada. Although no new large plants were brought into operation, an appreciable increase in the total of installed capacity in Canada accrued from additional units coming into operation in existing stations, principally in those which were partially completed last year.

Also, excellent progress was achieved on other developments actively under way, the labor situation and the availability of materials being relatively favorable throughout the year.

Installed capacity in Canada which, with the addition of 272,050 hp located in the new province of Newfoundland, now totals 11,622,668 hp, was increased during the year by 479,900 hp; this increase is slightly greater than that of 1948 and is well in excess of the prewar yearly rate of expansion of about 300,000 hp. A number of large developments which are in a state of advanced construction will add about 1,500,000 hp within the next two years, while other developments are in the preliminary stages of construction or are definitely planned; also, more long-range plans and investigations envisage the development of other sites, several of high capacity.

In the field of power distribution, construction similarly was very active. New main transmission lines were completed or were under construction in most sections of the country. Many new transformer stations and substations were built and secondary lines were extended. Rural electrification was particularly active in Quebec, Ontario, and Manitoba.

During the year the demand for hydroelectric energy continued to expand throughout the country as a result of a high level of industrial activity in conjunction with increased commerical, domestic, and rural consumption. The increased overall demand is reflected in the consumption of primary power which, according to the records of the Dominion Bureau of Statistics for the first ten months of 1949, increased 3.1 per cent over that for the same period of 1948, the previously high year, and 12.9 per cent over 1947. However, despite the additions to generating capacity which were made in 1948 and 1949, total production of central electric stations in 1949 was only 2.8 per cent greater than that of 1947. In general, stream-flow conditions were unfavorable for a considerable part of the year and, at times, some of the large hydroelectric systems had difficulty in meeting all power demands. The completion of a number of the larger plants which are now under construction will be necessary before essential reserve capacity becomes available.

The report covers in brief outline the hydroelectric undertakings which have been built, are under construction, or are more or less definitely planned. There are as well other large projects which have been under investigation in various parts of Canada which undoubtedly will be undertaken within a few years. While a large number of the more convenient and attractive sites have already been developed, there is every prospect that further development of Canada's great water-power resources will continue in future years and that the basic power demands of expanding economy for some time to come will be supplied in large measure from hydraulic sources.

AEC Construction

A U.S. Atomic Energy Commission booklet entitled "A Guide for Contracting of Construction and Related Engineering Services," which describes how AEC construction and architect-engineer contracts are awarded, was placed on sale recently by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for a price of 10 cents.

The booklet contains information on the various types of contracts used by the AEC, including lump-sum, fixed-price, and cost-plus-a-fixed-fee contracts, and describes the steps firms should take to be considered for those types of work where bids cannot be solicited by formal advertising.

The basic AEC contracting policies affecting construction and engineering services are described in the booklet as follows:

1 To the fullest extent feasible, construction contracts are made on a lump-sum or unit-price basis using formal advertising procedures.

2 Where formal advertising cannot be used, as full and free competition as is feasible is obtained to secure the required services.

3 Special effort will be made to place contracts with small-business concerns competent to perform satisfactorily.

Last August the AEC published a booklet entitled "Contracting and Purchasing Offices of the Commission and the Types of Commodities Purchased," which also provides information of interest to firms wishing to do business with the AEC. It is also available from the Superintendent of Documents for a price of 10 cents.

New Construction Technique

A BUILDING method using reinforced-concrete slabs and new construction techniques designed to reduce costs has been developed by the Institute of Inventive Research, San Antonio, Texas, and will be used in the erection of Trinity University's new administration building in San Antonio, it was disclosed recently.

Termed the Youtz-Slick method, it is said to be fundamentally a new technique for casting floor and roof slabs without forms and raising them to permanent positions using automatic power-lifting equipment. The method, it is claimed, eliminates forms for monolithic-concrete work and simplifies operations generally.

The following description of the new method was released by the Institute:

Foundations are poured in place and followed by the pouring of a base slab. Columns of pipe, structural steel, or concrete are then placed, anchored, and grouted. The roof slab, or the second floor and roof slabs if the building is two-story, is laid on the base slab which is used as a bottom form, thereby requiring only edge forms.

Concrete is then poured directly on the base slab over a separating medium and allowed to cure for at least seven days. Specially designed lifting equipment is placed on the columns and attached to the slab. The slab then is raised to its per-

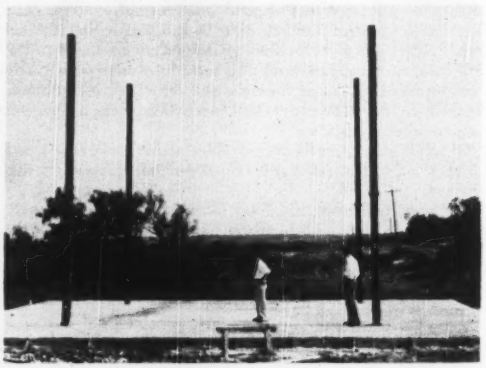


FIG. 17 SECOND-FLOOR REINFORCED-CONCRETE SLAB LAID ON TOP OF BASE SLAB IN EXPERIMENTAL BUILDING AT INSTITUTE OF INVENTIVE RESEARCH, SAN ANTONIO, TEXAS

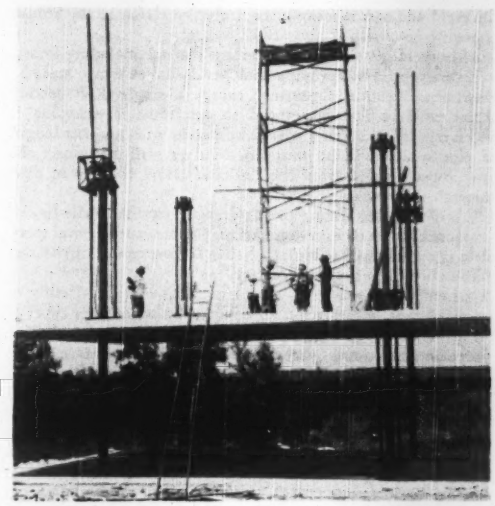


FIG. 18 RAISED SECOND-FLOOR SLAB READY FOR WELDING INTO POSITION

manent position and welded to the column by means of a collar which was placed in the slab at the time of pouring.

The method is said to be adaptable to multistoried construction and plans and specifications for such use are in preparation.

Indications are that the new method, if properly used, will cut construction costs by eliminating the forms and shoring for "upstairs floors" and roofs.

Construction bids for the new Trinity University buildings disclosed that use of the newly developed Youtz-Slick building method may lower costs some 10 per cent. Low bids on the University administration building were as follows: Youtz-Slick method $279,364 or $6.35 per sq ft; conventional method $303,364 or $6.89 per sq ft.

This means a saving of $24,000 (or 54 cents per sq ft) to the owner, representing a substantial reduction in costs by use of the new method, and an unusually low-cost figure, generally speaking.

Paint Rollers

APPLYING paint to flat surfaces by rollers has grown out of the gadget class into a precision tool acceptable to the craftsman, according to the January, 1950, issue of the *Industrial Bulletin* of Arthur D. Little, Inc. Although rollers will probably never completely replace paint brushes, the article states, they offer many advantages over traditional methods.

Brush painting is a slow process, with 12 per cent of the painter's time spent merely in dipping the brush into the paint pot. Brushes themselves are expensive; 4½-in. bristle sells now for about $14 a lb, and 80 per cent of the cost of a brush is in the bristle. Although the nylon filaments which have been developed for paint brushes are considerably cheaper, many professional painters still prefer hog bristle.

Spraying is one means of reducing the cost of paint application. It has become indispensable in many applications, such as assembly-line operations, or painting of large unobstructed areas. Great economy has been introduced in painting small objects on a production line by applying a high electric potential between the spray gun and the work, thus attracting the charged particles of paint which would otherwise pass into the ventilating ducts. The reduction in labor, however, has met with opposition from unions, who frequently forbid use of spray guns. It is difficult, moreover, to control the spray for precision work. Besides contaminating adjacent surfaces, the mist may sometimes offer a health hazard to workers.

Paint rollers overcome many of the limitations of brush and spray painting, especially for interior walls, and are being used increasingly. The simplest rollers are hollow cloth-covered cylinders which rotate on an axle. They are held by a long handle dipped into a pan of paint, and rolled along the surface to distribute the paint. They were first marketed widely by Sherwin-Williams, when water-thinned oil and resin paints were introduced, and improvements in the cloth coverings have made them suitable for conventional oil-base paints. The original rollers had a lamb's wool cover, but recent models are covered with a wool pile woven into seamless porous backing. It is easily removed and may be washed repeatedly.

Further development work by the Rubberset Company has produced paint rollers in which the flow of paint to the working surface is under the complete control of the painter. One recent model has the paint reservoir in the handle, and in another type the paint is stored under air pressure in a tank, from which it is fed to the roller. Substantial economies have resulted from the use of rollers on unobstructed interiors. Furthermore, paint spattering has been reduced until drop cloths are unnecessary.

Rollers have limitations; a brush is still required for corners and trim, but wheel-shaped rollers are a possibility for these special uses. The rollers cannot force paint into deep crevices, such as the gap between shingles, although special types of fabric may eventually overcome this difficulty.

Smog Prevention

SMOG is a contraction of the two words "smoke" and "fog" and is used to describe an atmospheric condition in which the particulate matter (unburned hydrocarbons, etc.) present in smoke adheres to the moisture in the air so as to discolor and pollute the air in a way which is hygienically undesirable and objectionable from the standpoint of cleanliness, and the like.

To meet the needs, therefore, of its members in Southern California which are under compulsion to meet the demands of local municipal regulations covering smoke and smog abatement, the Gray Iron Founders' Society of Cleveland, Ohio, has recently released a 27-page report on cupola dust suppression.

Based upon a 79 per cent return of a questionnaire mailed to 43 smoke-abatement and air-pollution officials throughout the country, the report revealed that no state codes contain any limitations on dust loading in flue gases. Such codes as do exist are confined to municipal ordinances. There is no generally recognized standard, however, but 0.40 grains per cu ft of effluent gases would be a fair average, and is, incidentally, the standard most frequently encountered. The best reference, the report indicates, is the standard recommended by The American Society of Mechanical Engineers, which calls for a limit of 0.45 grains per cu ft of effluent gases.

In order to determine the size of the problem, smoke-prevention experts were asked about the number of complaints received relative to foundry cupolas.

Twelve cities said they had had no such complaints whatsoever. Three cities said they had had numerous complaints. One said they had had 40 to 50 complaints; one said about 20; another said about 20 a year; another has had only 2; another

reported several; one each said "Few," "A rarity," "Not severe," "Not a pressing problem."

From the foregoing it will be seen that while most of the reports indicate no problem or a problem of no great severity, in some cases complaints are numerous and should be given careful consideration. That would be true even if there were only one city having such a problem. It can be fairly stated therefore that a real problem does exist which should claim attention.

The report therefore presents valuable information on the various methods of dust suppression. Photographs, charts, and operating data are included on equipment by leading manufacturers in the field, as well as on installations developed by individual foundries.

The report contains background information on the industry and sets forth the basic principles in dust suppression. Both wet and dry dust suppression and electrical precipitation are described.

The following recommendations were reached and are outlined in the report:

1 Realize and appreciate that cupola dust suppression is a relatively new science and adopt the attitude that, this being so, no one in this field is justified in insisting that certain debatable standards must be met—and at once.

2 Since there are no standard tests to determine the improvement brought about by installing dust-suppression units, research should be carried on by air-pollution authorities to establish such standard tests and equipment.

3 If a locality desires that air pollution be a fixed (arbitrary) value, it should be well recognized that the community itself should foot the research bill. They want the foundries to meet a fixed standard of performance, hence they should pay to determine how this can be accomplished.

4 A correlating board in the professional organization of smoke commissions, hygienists, etc., should be set up to maintain up-to-the-minute information in this field and keep their members currently informed.

5 Work with and not against industries. They will cooperate far more readily if treated with respect and consideration—not classed as obstructionists to be chastised and penalized.

6 Pass on to the Gray Iron Founders' Society, Inc., all up-to-the-minute information in this field and others, so that they can pass the data along to their members.

7 Carry on scientific studies, possibly financed by the government, to develop the one best method of solving this problem.

Aluminum Gas Line

AN aluminum gas line, said to be the first to be installed in the nation, will be an all-welded line that will extend underground approximately 1.8 miles from the main trunk line of the Alabama-Tennessee Natural Gas Company to the Listerhill, Ala., plant of Reynolds Metals Company.

The line consists of extruded-type 63S-T6 aluminum-alloy pipe measuring $8^5/_8$ in. OD. Walls will be $^1/_4$ in. thick. The line is designed for a working pressure of 200 psi and a bursting pressure of 1750 psi.

The pipe comes in 40-ft lengths and is joined by straight butt welds. Ends are prepared for welding by making a 30-deg bevel at the mill so no end preparation will be necessary on the site. The weld is made with two passes, using $^3/_{16}$-in-diam 5 per cent silicon-type aluminum rod. No flux will be employed since the Heliarc method will be used. This system provides a complete shield of inert gas around the weld zone, protecting the weld and surrounding metal from the action of the atmosphere.

After welding, the entire length of the line including joints, will be wrapped by applying cold No-Oxid pipe wrap, made by Dearborn Chemical Company, except a single 40-ft section which will be left unwrapped to determine if wrapping is necessary. This section will be by-passed with another length of pipe which will be wrapped. Valves will disconnect the unwrapped section from the line and allow the gas to flow through the by-pass.

It is planned to dig up the unwrapped section of the line at six-month intervals for examination. Some experimental work already completed has indicated that the wrapping of the aluminum pipe may not be necessary.

A careful cost analysis is to be made of this installation to furnish factual information for comparison with other types of lines. It is expected that important economies in installation and maintenance may offset any differential in material cost.

Radiant-Heating Panels

RADIANT-HEATING panels should be located in the ceiling in preference to the floor of a building in the interest of maintaining proper vascular tone in the foot and leg, L. P. Herrington, director of research, and R. J. Lorenzi, research engineer, of the John B. Pierce Foundation, Laboratory of Hygiene, New Haven, Conn., told the American Society of Heating and Ventilating Engineers at its 1950 annual meeting in Dallas, Texas.

They reported on a series of tests in which they kept a room in a test house at a temperature of 75 deg F first, by the use of floor panels and then by ceiling panels. They said that the temperature of the lower extremities of two young men used as subjects was two degrees warmer when floor heating was used than in the case of ceiling heating. The engineers said location of the radiant-heating panel in the ceiling did not produce a significant effect on head temperature.

One of the primary conditions of thermal comfort is a skin temperature ranging from approximately 80 deg on the toes and sole of the foot to approximately 95 on the trunk and certain facial areas, with an over-all average for the skin surface of 90–92 deg, they declared.

The authors said that outside shoe temperatures are 10 deg or more below foot surface temperature. With floor panels operating at 79 deg in order to produce the desired room temperature of 75 deg, the floor temperatures in the tests average 78.5 deg, as compared with an average floor temperature of 72.8 when ceiling panels were used. Stating that they believed it necessary to avoid local heating effects which may induce low vascular tone in the foot and leg, the authors declared that floor temperatures above 75 deg are not desirable.

High vascular tone in the lower extremities is necessary to maintain competent circulation in the more vital regions of the body, they said.

One of the conditions of an alert subjective state is the maintenance of this vascular tone, and in consequence, foot temperatures are considerably below the general skin average.

The reality of this relation of tone in the lower extremities to their temperature is demonstrated conclusively in relation to the sudden rise in lower-extremity temperature with anesthesia and on falling asleep.

The author stated that since psychic relaxation under conditions which require alertness is closely akin to certain sensations of dullness and fatigue, it appears desirable, in heating procedures, to avoid local heating effects which may induce low vascular tone in the foot and leg.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Air-Cargo Transportation

Air Cargo Today—It Is Here to Stay, by Charles Froesch, Eastern Air Lines, New York, N. Y. 1949 ASME Annual Meeting paper No. 49—A-147 (mimeographed).

This paper emphasizes that air cargo is here to stay, having proved that merchandise of a relatively high value per pound or cubic foot can be most economically transported by air at an overall savings to both shipper and receiver.

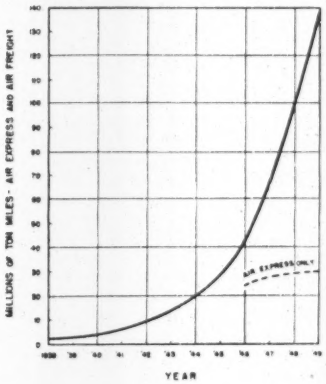
Today the country is well covered with a network of convenient air-cargo schedules operated by the scheduled airlines and all-freight carriers recently certificated by the Civil Aeronautics Board, with over 200 cargo transports carrying a collective 220,000 ton-miles per hour.

It is pointed out that the speed advantage of air freight permits merchants to keep minimum inventories, meaning low capital investment and high merchandise turnovers. This is of particular advantage during periods of falling prices.

During the past 11 years the volume of air cargo, which includes both air express and air freight, has risen from 2,200,000 to an estimated 135,000,000 ton-miles for 1949. But before air-cargo volume can reach the size it rightfully deserves, it will be necessary that aircraft specially designed for cargo service be used, handling costs reduced, and proper warehousing and distributing facilities be erected in order to lower operating costs, give the shipper and receiver the best possible service, and earn a profit on the capital investment of the operator.

Few airports in the United States have proper warehouse and cargo-handling facilities, because of the high cost, it is pointed out. Large platform-type buildings used as air-cargo terminals, are necessary at the airport. Docks of truckbed height must be made available for the loading and unloading of commercial trucks and trailers shuttling merchandise back and forth between generating centers and the airport. Such platforms must be of suitable height to load and unload aircraft by conveyers, movable fingers, or gangplanks.

It is emphasized that separate cargo-terminal facilities should be provided at each airport where cartage agents could deliver or pick up large shipments of air freight by a single truck movement to expedite transportation to and from the airport.



GROWTH OF AIR-CARGO (EXPRESS AND FREIGHT) 1938–1949

Tomorrow's Cargo-Aircraft Specification, by W. W. Davies, United Air Lines, Inc., So. San Francisco, Calif. 1949 ASME Annual Meeting paper No. 49—A-134 (mimeographed).

The paper outlines the necessity of improving cargo aircraft, stating that since speed is the primary asset of air transportation, the cargo airplane will be a high-speed transport.

Prime importance in the air-freight operations of the future is the ability to maintain high schedule reliability. On-time performance will continue to be as important to cargo-aircraft operation as it is to passenger-aircraft operation. The airplane requires the latest communications and navigational equipment and adequate anti-icing equipment. The safety of the cargo airplane is as important as it is for passenger craft.

An effort should be made in the cargo

How to Order ASME Papers

PAMPHLET copies of ASME papers referred to in this section are available, until the supply is exhausted, at 25 cents each to members; at 50 cents each to nonmembers. ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING are not included in this Digest Section.

To facilitate ordering papers, coupon books, each containing ten coupons, are available to members at $2 each, to nonmembers at $4 each. These coupons may be used to purchase papers presented at ASME Meetings.

When not using coupons, remittance must accompany all orders for $2 or less.

When ordering, please give number assigned to article, title, author's name, and number of copies wanted. Orders should be sent to the ASME Order Department, 29 W. 39th St., New York 18, N. Y.; or, use convenient order form below.

NOTE: ASME Publications and advance copies of ASME papers are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th St., New York, N. Y. ASME Transactions and *Journal of Applied Mechanics* are also on file in ASME depositories maintained in 245 libraries in the United States, including libraries of all ASME Student Branch institutions.

ASME Order Department
29 W. 39th St., New York 18, N. Y.

Date.....

Please send me the papers indicated by the following circled numbers:

49—A-88,	49—A-108,
49—A-90,	49—A-111,
49—A-102,	49—A-131,
49—A-103,	49—A-133,
49—A-104,	49—A-134,
49—A-105,	49—A-135,

49—A-147

Name.....

Address.....

☐Remittance enclosed ☐Bill me

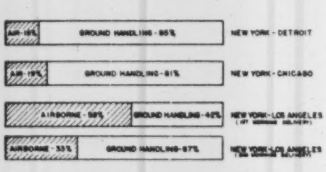
☐ASME Mem. ☐Nonmem.

airplane of the future to design and work toward presently and generally accepted means of shipping and materials-handling equipment, rather than the development of special and costly equipment which offers questionable gain in the long run. There will be, undoubtedly, a much more expanded use of preloaded containers and pallets whereby the cargo can be handled quickly and efficiently in and out of the airplane.

One other strong point in the design and operation of the future cargo airplane is the development of equipment that is simple—simplicity of design, operation, and maintenance.

Improvements Required in Air-Cargo Ground Handling, by R. Dixon Speas, American Airlines, Inc., New York, N. Y. 1949 ASME Annual Meeting paper No. 49—A-131 (mimeographed).

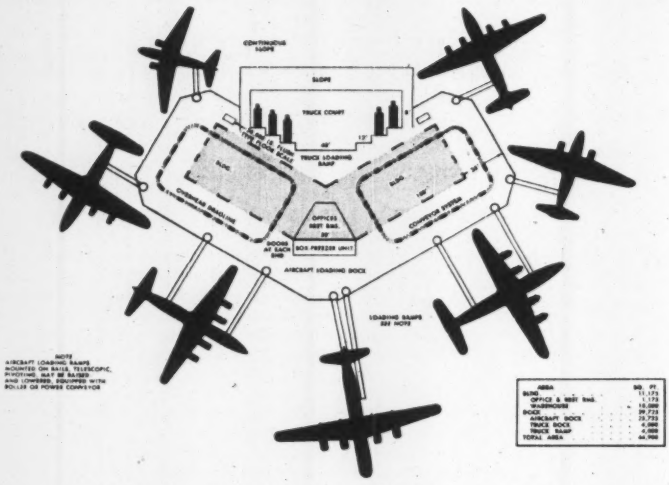
The importance of air-cargo ground handling is stressed, and the improvements required in this phase are discussed. Some specific recommendations made are: The need for a careful and objective study of the cargo flow from shipper to consignee; speeding up pick-up and delivery services; better aircraft utilization; improved cargo-terminal design with better plane-to-dock facility features; streamlining of paper work with regard to cargo operations; more efficient utilization of man power at the cargo terminal; and reliable cargo security through training and discipline of personnel and actual testing of shipments.



IN-TRANSIT TIME SURVEY; AIRFREIGHTER SHIPMENTS—AIR-LINE X AIRFREIGHTER OPERATION, NOVEMBER, 1949

In such considerations, the paper concludes, the potential of the new industry appears great, and, coupled with the inherent advantages of air transportation, there appears the foundation and the making of a great industry.

Transportation of cargo by air not only should be a profitable business from a commercial standpoint, but can and must be the means for providing a strong reservoir of cargo aircraft for national security.



LOCKHEED PLAN FOR BASIC AIR-FREIGHT-TERMINAL LAYOUT

Experience and Future Requirements of Military Air Cargo, by Maj.-Gen. William H. Tunner, U. S. Army Air Force, Andrews Air Force Base, Washington, D. C. 1949 ASME Annual Meeting paper No. 49—A-135 (mimeographed).

The subject of military air transportation as a force for peace is covered in this paper which reviews some of the early military air-freight experiences, discusses the recent Berlin airlift, and describes what the military needs in a cargo-transport aircraft. The primary consideration in design, it is pointed out, must of course be an aircraft able to accomplish the mission, but with maximum economy.

Perhaps the most significant contribution to cheap and dependable air transportation is low maintenance requirement.

Aircraft engines, in addition to being dependable and rugged, must be designed so that they can be replaced in a few minutes. Continuous operation between engine overhauls should be at least 1200 hr.

Electric and hydraulic systems must be simplified.

The airplane must be designed to permit loading and unloading from normal truck bodies with the minimum use of auxiliary equipment.

The contour of the cargo-transport airplane should emphasize a fuselage design sufficiently wide to permit storing of two passenger-type vehicles or equivalent items side by side throughout its usable length.

Cargo doors, of which there should be more than one, must be ample in size to permit the direct ramp loading of a 6 × 6 truck with its canopy.

The airplane should be a conventional 4-engine type, capable of laying down 25 tons after a 3000-mile flight, or 5000-mile range with no load.

The airplane should have the ability to climb to 20,000 ft with a full load and to sustain operations at that altitude, permitting overflying normal bad weather found in transatlantic crossing.

Electronic navigational equipment is also desired, including radio and radar altimeters, instrument-landing system, and long-range aerial-navigation radio and radar equipment.

Planning the Air-Freight Terminal, by L. R. Hackney, Lockheed Aircraft Corporation, Burbank, Calif. 1949 ASME Annual Meeting paper No. 49—A-133 (mimeographed).

This paper stresses the fact that the expansion of the air-freight industry will be retarded until such time as adequate and intelligently planned terminals are provided.

In many instances the cost of handling air freight from the consigner into the airfreighter and from there to the consignee approaches the actual expense of the air haul. Also, it is not uncommon to have the time during which the freight is on the ground in pickup and delivery, waybilling and manifesting, loading and unloading, exceed the time the freight is in the air.

The military logistics value of a series of properly designed and equipped air-

freight terminals of standard design can be of untold value in the event of national emergency, it is pointed out. These terminals could be utilized by the Military Air Transport Service to supplement their existing facilities, for in time of national emergency there is always a need to requisition and transport vast supplies of critically needed materials. The commercial air-freight terminal would provide an important link in this chain. In times of stress its normal capacity could be increased many times over on an "around-the-clock" basis.

Hydraulics

Centrifugal and Axial-Flow Compressors Hydraulic Performance, by A. J. Stepanoff, Mem. ASME, Ingersoll-Rand Company, Phillipsburg, N. J. 1949 ASME Annual Meeting paper No. 49—A-88 (mimeographed).

This paper presents a chart of blower performance characteristics and design elements covering the whole field of centrifugal and axial-flow types. Although originally devised for centrifugal and axial-flow pumps, the chart is equally valid for gas blowers when extended to higher-impeller-discharge angles. It is drawn for a meridional impeller inlet (radial or axial); however, provision easily can be made to take care of prerotation in either direction. A number of necessary definitions and deductions, not widely known, are briefly discussed.

The chart was originally established for centrifugal-pump test data in sizes where the scale effect becomes insignificant, and performance approaches optimum. The blower data fall very well on the chart for good blowers covering impeller-discharge angles from 25 to 90 deg. For the latter group (superchargers) the chart gives the head coefficient $\psi = 0.685$ a value actually realized on best commercial units. For smaller units or defective designs the head-capacity points fall below their respective lines of discharge angles, indicating that hydraulic efficiency is below par. Deviations may be caused also by the design of the impeller suction approach (or exaggerated impeller entrance vane angle). But the chart properties remain unchanged, i.e., after a point is placed on the chart the actual discharge velocity triangle can be drawn and any variation of the basic design elements will produce change in performance (values of ϕ and ψ) as indicated by the chart.

Investigations of Axial-Flow Compressors, by J. T. Bowen, Jun. ASME, R. H. Sabersky, Jun. ASME, and W. D. Rannie, California Institute of Technology, Pasadena, Calif. 1949 ASME Annual Meeting paper No. 49—A-102 (mimeographed).

During the past few years the multistage axial-flow air compressor has become a frequently used component in gas-turbine systems. Single-stage axial-flow pumps and fans had previously found numerous industrial applications. However, much of the development work on such devices has taken place under conditions which require that a working machine be produced in the shortest possible time, and relatively few fundamental investigations of internal-flow patterns have been made. Perhaps the most extensive work has been done by British investigators and by the NACA in this country.

Previous to the inception of this experimental program, a theory of perfect fluid flow in axial turbomachines had been developed by the senior author. One of the principal objects of the experimental work was to determine the correctness of the theory. This theory has not been widely available and is therefore summarized in this paper.

It was believed that verification of the validity of the compressor theory and considerable information on the location and magnitude of major losses could be obtained from tests in the low-speed, low-Mach-number regime of operation. The minor influence of fluid compressibility up to the first appearance of sonic velocity can be predicted satisfactorily from low-speed data. Hence a relatively large low-speed compressor of one to three stages was constructed. Since the main emphasis of the program is on the study of internal flow, considerable attention has been devoted to internal instrumentation. The results obtained in the first two years of testing are summarized in this paper.

Specifically, this paper presents an approximate theory of the general perfect fluid flow in axial turbomachines. The validity of the simplifying assumptions of the theory is justified by comparison with flow patterns measured in a large, low-speed-axial-flow compressor. It is concluded that the theory is convenient to apply and is sufficiently accurate for most engineering purposes. Performance data on blading designed for two- and three-dimensional flow show that the blade types have comparable efficiencies. It is suggested that the advantages of unconventional blade types be exploited by designers. The flow regions in which fluid viscosity is important are shown. Experimental studies of cascade losses in the compressor indicate these losses to be greater than those measured in a cascade test tunnel. Measurements show that the rate of growth of the wall boundary layer need not be unusually great in an axial-flow compressor.

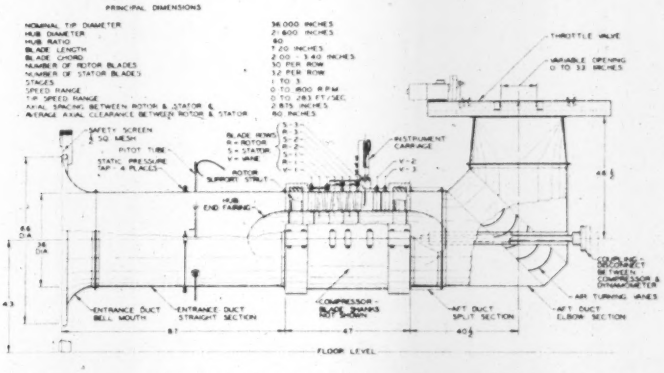


DIAGRAM OF TEST INSTALLATION USED IN AXIAL-FLOW-COMPRESSOR INVESTIGATION

Resistance to Rotation of Disks in Liquid, by Austin H. Church, Mem. ASME, and Stanley A. Gertz, Jun. ASME, New York University, New York, N. Y. 1949 ASME Annual Meeting paper No. 49—A-103 (mimeographed).

The purpose of this paper is to examine the retardation of a disk rotating in a liquid which is important in the design of centrifugal hydraulic machinery. The work of previous experimenters is reviewed and the factors involved are discussed. Tests on oil and water are described, the results analyzed, and correlated with those of earlier investigators. A formula, based on the Reynolds number of the disk and liquid, is ob-

tained which includes the properties of the liquid and the side clearance.

According to the paper, the retarding action of the fluid on the disk is caused by the following factors: (1) Shearing of the layers of fluid, since the fluid in contact with the disk rotates at the disk speed, while that in contact with the case is at rest; (2) pumping action of the disk on the fluid, since the fluid near the disk is thrown outward by centrifugal force and circulates between the disk and case.

Hence the power absorbed is not entirely caused by "friction," and the name "disk friction" commonly applied to this phenomenon is a misnomer. It is used here because of its widespread acceptance in the hydraulic-machinery field.

The factors affecting the power absorbed include: the peripheral speed of the disk which may be taken as its tip speed u, the side clearance s, the absolute viscosity of the liquid μ, the disk diameter D, the mass density of the liquid ρ, the rotative speed of the disk n, and the surface roughness.

The paper concludes that most of the current equations used in determining the disk-friction horsepower with water as a liquid appear to be a bit conservative over all or part of the Reynolds number range investigated.

The decimal exponents used in some of the equations imply a Reynolds number effect, and are based upon average values of viscosity, specific weight, and side clearance.

The following equation for the disk friction is given:

$$hp = 0.00725\gamma\rho^{0.065}\delta^{0.11} \times \left(\frac{d}{10}\right)^{4.87}\left(\frac{n}{1000}\right)^{2.935}$$

Head and Flow Observations on a High-Efficiency Free Centrifugal-Pump Impeller, by W. C. Osborne, Jun. ASME, and D. A. Morelli, California Institute of Technology, Pasadena, Calif. 1949 ASME Annual Meeting paper No. 49—A-108 (mimeographed; to be published in full in Trans. ASME).

A series of studies of the flow through the various components of hydrodynamic machinery is in progress in the Hydraulic Machinery Laboratory of the California Institute of Technology. Observations have been made on an impeller patterned after the Grand Coulee design. The impeller was operated as an isolated unit hydraulically free of the casing. The flow pattern at the discharge has been quantitatively determined for one flow rate and a head-capacity curve for the impeller has been obtained. This paper constitutes a report on the findings up to the present.

The apparatus used covers the following ranges: (1) Flow rates up to 4 cfs with a head differential of 66 ft at the test unit; (2) power input or absorption up to 30 hp; (3) dynamometers capable of rotative speeds of 100–200 rpm in either direction.

The physical size of the test elements is not rigidly fixed. However, rotating channels up to 12 in. diam and diffuser or volute casings up to 30 in. diam may be accommodated.

A three-dimensional photographic technique was used in making the quantitative-flow studies. Thus the problems of instrument response and obstruction to the flow presented by mechanical methods were eliminated.

The tracer paths were recorded with a stereoscopic camera. The stereoscopic technique was necessary to establish the axial position or third dimension of the tracers in the passages.

The test impeller was operated at 150 rpm and a capacity of 0.293 cfs. At this capacity it was possible to operate the impeller both with and without the collector, and hence make comparative studies.

Francis or Impulse—The Influence of Wear and Operating Conditions, by A. Puyo, Neyrpic, Grenoble, France. 1949 ASME Annual Meeting paper No. 49—A-111 (mimeographed).

In establishing a hydroelectric project there is sometimes a question as to whether a Francis or an impulse turbine is more suitable.

For a unit of 30,000 hp under 2500 ft head everyone agrees to use the impulse turbine. For a unit of 20,000 hp under 300 ft head everyone would use a Francis wheel. But when a unit of 25,000 hp under 1000 ft head is considered the discussion becomes quite animated and partisans for each solution are found. The line of demarcation between the use of impulse and Francis wheels is not a fixed and well-determined line, but depends on numerous technical and economic factors which may vary with the place and date.

This paper discusses the situation with the present state of development of both types, studying the relative importance of various factors which weigh on the choice of Francis and impulse wheels. The study is limited to heads over 500 ft so as to confine the study to controversial units of a reasonable size.

The impulse turbines involved are turbines of several jets and possibly several wheels. The specific speed per jet is not constant along the proposed boundary line, for wheels which are mechanically suitable under 500 ft may not be suitable under 1000 ft. In line with their experience and manufacturing facilities, different builders propose either horizontal units with two wheels and two jets per wheel, or vertical single wheel units with three to six jets, high specific speed being obtained either by a relatively slow wheel allowing five or six jets, or by a faster wheel with three or four jets.

Similarly, the Francis units found in the controversial region are not identical, although there is probably less variation between the Francis units than between the impulse units.

According to the paper, impulse wheels being more rugged are generally preferred by the power companies and require less maintenance. This difference becomes especially noticeable if the water is carrying abrasive particles. The comparison of the performance of Francis and impulse units when there is appreciable wear seems to be the fundamental factor.

It is pointed out that during the first years of service, (5000 to 10,000 hr) after reconditioning, the influence of wear on the efficiency is comparable in impulse and Francis turbines (1 to 2.5 per cent), from ¾ to full load. It is greater in Francis turbines as soon as the load drops: at half load about 5 per cent against 2 to 3 per cent in impulse.

After a long period of service, the impulse turbines take manifest advantage, even at full load; at part load the difference increases.

These conclusions concern power plants using relatively clear water. The difference must be greater with water carrying abrasive particles or if the Francis turbines operate under poor conditions in respect of cavitation.

Railroads

Materials Handling in Railroad Service Shops, by S. H. Hammond, Whiting Corporation, Harvey, Ill. 1949 ASME Annual Meeting paper No. 49—A-90 (mimeographed).

The large investment by railroads in motive power and rolling stock, and the need for its efficient operation, require adequate servicing facilities. A large part of the servicing operations involve materials handling. With today's high labor costs, this presents a fertile field for cost reduction through mechanization. Various types and applications of mechanical equipment are described and

illustrated. Better materials-handling methods promote greater safety, improve morale, speed up operations, and reduce unit costs.

There are other benefits to be obtained from efficient materials handling that are even more important sometimes than reduced costs. There is the elimination of waiting time by the men at the machine plus the utilization of existing production space to better advantage. Better handling facilities mean less danger of damage to the product. Work in process is kept moving from one machine to another without clogging aisles, which makes for better working conditions.

It is pointed out that many comprehensive programs for modernization of steam-locomotive-repair facilities have been held in abeyance because of the coming of the Diesel. As a consequence, the cost of maintaining steam power has risen on most of the roads where Diesels have replaced steam units on the better runs. Many railroad officials apparently decided that with the advent of the Diesel, steam locomotives would soon be gone and there was no reason to spend money on maintenance facilities for them.

However, the paper concludes, since 80 per cent of the motive power of this country is still of the steam type, thousands of steam locomotives would be in service for many years to come.

Attracting, Training, and Retaining the Engineering Graduate in the Railroad Industry, by F. K. Mitchell, Mem. ASME, New York Central System, New York, N. Y. 1949 ASME Annual Meeting paper No. 49—A-104 (mimeographed).

This paper describes the methods followed and results being obtained in the training and retaining of engineering graduates in the Equipment Department of the New York Central System. This department is responsible for the design of electric, steam, and Diesel locomotives, passenger, freight, and work-equipment cars, power plants, shops, shop machinery, and special devices. After the design is completed the department is responsible for the construction of this equipment, and thereafter for its maintenance and operation. Engaged in this task are about 200 men on strictly engineering work, and some 2000 men in supervisory positions on maintenance work whose positions the new mechanical and electrical graduate could aspire to. Quite frequently, also, Equipment Department engineers and supervisors are transferred to positions in other departments, thus broadening the field of advancement materially.

Since 1901 the New York Central has had a special apprentice course designed to fit the engineering graduate for these positions. Over the years this course has varied considerably, the final system having been evolved some five years ago, at the close of World War II. The results thus far have been highly satisfactory, and since putting the new system into effect the retention rate is approximately 80 per cent.

Attached to the paper are the following exhibit sheets: (1) Requisites for special apprentice course; (2) Progress report on special apprentice; (3) Schools from which New York Central special apprentices graduated; (4) Served special apprenticeships but now out of service, and (5) Former special apprentices still in service.

Student Apprentice System on Southern Railway, by J. B. Akers, chief engineer, Southern Railway System, Washington, D. C. 1949 ASME Annual Meeting paper No. 49—A-105 (mimeographed).

The Student Apprentice System on Southern Railway System lines was a result of difficulties experienced in the selection and training of men for positions of officers from track supervisor and trainmaster to the highest positions. In the earlier years gang foremen were promoted to the positions of track supervisor and bridge and building supervisor, and then to roadmaster (division engineer now); train conductors and dispatchers were usually promoted to positions as trainmaster and subsequently to superintendent and higher positions.

It was recognized about 1912 that this system would not produce sufficient men for the future, nor would it take into consideration any educational training which then seemed very desirable.

Accordingly the Student Apprentice System was adopted and the first class of such men were employed in 1914. The idea was to select young men just out of college and who had the benefit of an engineering degree, if practicable to do so. The preference is for those graduates who have displayed some mark of leadership in college, such as president of a debating society, editor of the college paper, etc.; in fact, anything which would give the man some distinction. Men who were raised on a farm would be given some preference.

These men are placed in service with a section force under a selected foreman. Here he will learn the day-by-day maintenance work of smoothing rough places, gaging track, adjusting switches, and the like. After he has been in service a year or more he is then given a course which will consume several months in other departments. In this particular part of the training he will spend sufficient time in a freight agency, with a trainmaster, with a division freight agent or other traffic officer, in the personnel office, and in the mechanical department. The intention is that the apprentice will get a broad background of what is required in railway service in other departments.

After the apprentice has served a suitable length of time and has reached a point where it is considered desirable, he is promoted to the rank of tract supervisor. Further promotion is altogether dependent upon merit.

ASME Transactions for February, 1950

THE February, 1950, issue of the Transactions of the ASME contains the following:

Symposium on Marine Fouling:

Some Biological Fundamentals of Marine Fouling, by W. F. Clapp. (49—S-15)

Project Study for the Mitigation of Marine Fouling, by I. A. Patten. (49—S-20)

Control of Marine Fouling in Sea-Water Conduits Including Exploratory Tests on Killing Shelled Mussels, by H. E. White. (49—S-12)

Thermal Control of Marine Fouling at Redondo Steam Station of the Southern California Edison Company, by W. L. Chadwick, F. S. Clark, and D. L. Fox. (49—S-13)

Discussion on four preceding papers.

Forming of a Plastic Sheet Between Fixed Cylindrical Guides With Coulomb Friction, by H. I. Ansoff. (49—SA-22)

Motor-Generator Locomotives, Their Design and Operating Characteristics, by J. C. Fox, J. F. N. Gaynor, and F. D. Gowans. (49—SA-7)

Two Slants on Postwar Wood Finishing: Part I—Current Practice, by P. S. Kennedy. (49—WDI-2)

Part II—Suggested Method for Predicting Check Resistance of Lacquer Films, by W. T. Smith. (49—WDI-2)

Effect of Fuel-Immersion on Laminated Plastics, by W. A. Crouse, Margie Carickhoff, and Margaret A. Fisher. (49—F-32)

Current Design Practices for Gas-Turbine Power Elements, by H. D. Emmert. (48—A-170)

Bending of an Ideal Plastic Metal, by J. D. Lubahn and G. Sachs. (48—A-168)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Engineering Design Analysis

COMMENT BY WILTON R. ABBOTT[1]

Mr. W. W. Soroka is to be congratulated on his excellent presentation of the classification of analog computers.[2] The comment which follows is concerned only with certain points found in that part of the paper entitled, "Problems Characterized by Ordinary Differential Equations and Their Solution by Analogies."

The statement, "There are as many equations to be solved simultaneously as there are masses in the system," is an oversimplification of the problem. For instance, Fig. 1 of this discussion shows a system with only one mass but which obviously requires two equations. A more general rule may be formulated. First define a node as a point at which two or more dissimilar elements are connected together. Let n be the number of nodes exclusive of the reference node, and e be the number of elements including all force and velocity sources. Subtract from n the number of velocity sources and from e-n the number of force sources. The first difference gives the number of equations needed if they are to be written in terms of the reactions at a node, and the second difference gives the number of equations needed if they are to be written in terms of the velocities around a closed loop. Obviously, the system yielding the smaller number of equations would be used. Applying these rules to Fig. 1 gives two equations in either system, so either may be used.

The author expresses a preference for the mass-inductance analogy. This preference is not, perhaps, completely justifiable. The author's objection to current sources is well taken; however, these will appear even in the mass-inductance analog whenever the mechanical excitation is a velocity source. In addition, whenever a current source in an electrical system is in parallel with a passive element or a combination of passive elements, an exchange giving an equivalent voltage source is possible. This has been discussed in an elementary fashion.[3] If we can eliminate current sources the principal objection to the mass-capacitance analogy disappears.

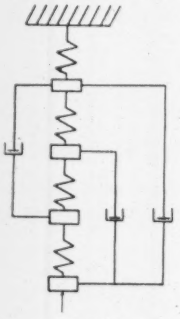


FIG. 1

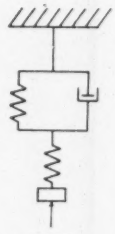


FIG. 2

An advantage of the mass-capacitance analogy is that it is set up so easily. Current nodes in the analog correspond to force nodes in the mechanical system. A spring connected between two nodes is analogous to an inductance between the same two nodes in the electrical system. Similarly, dashpots are analogous to resistors and masses to capacitors. The masses are considered as two-terminal devices connected between their node and the reference. Also, a force between two nodes is analogous to a current generator between the nodes, and a known velocity difference between two nodes is analogous to a voltage source.

A disadvantage of the mass-inductance analogy is that an analog does not exist for every possible mechanical combination. This is not a disadvantage of the mass-capacitance analogy. For instance, in Fig. 2 herewith, a differential equation for the mass-inductance analog can be written, but its interpretation in terms of an electric circuit is impossible. This is an example of a nonplanar system. If the circuit is completed by drawing a line from each mass to the reference, at least one crossing of lines is necessary. The mass-inductance analogy is possible only for planar networks. On the other hand, reference to the rules for finding the mass-capacitance analog shows no difference in their application to planar or nonplanar systems.

[1] Division of Electrical Engineering, University of California, Berkeley, Calif.

[2] "Experimental Aids in Engineering Design Analysis," by W. W. Soroka, MECHANICAL ENGINEERING, vol. 71, October, 1949, pp. 831–836.

[3] "Transients in Linear Systems," by M. F. Gardner and J. L. Barnes, John Wiley & Sons Inc., New York, N. Y., vol. 1, 1942.

Railroad Passenger-Car Power Plants

COMMENT BY F. H. BREHOB[4]

In connection with the subject of power plants for railroad passenger cars,[5] some further details of the particular development treated by D. R. MacLeod, may be of value.

Clearance Requirements. Owing to the location of the power plant underneath a passenger-car body, it appeared that, if clearance conditions were met on railroads which operated in third-rail territory, these conditions probably would also satisfy the majority of the other railroads in nearly all locations. Consequently, a design was developed for new postwar cars to meet third-rail clearances on the sharpest curves that would be encountered in third-rail territory. These cars may have a height from the underside of the side sill to the top of the rail as low as 42 1/4 in. When a generator is directly connected to a vertical engine, the over-all height of the power plant is fixed by the distance from the crankshaft to the top of the engine, and from the crankshaft to the bottom of the generator magnet frame. Fortunately, the vertical engine is reasonably narrow, which permits it to be placed far enough toward the center still to enable the clearance conditions to be met.

Noise and Vibration. The first few experimental units built by the writer's company employed rubber vibration mounts between the power plant and its

[4] Project Engineer, General Electric Company, Erie, Pa. Mem. ASME.

[5] "Under-Car Engine-Driven Power Plants for Railroad Passenger Cars," by D. R. MacLeod, MECHANICAL ENGINEERING, vol. 71, November 1949, pp. 921–924.

support. Sound-absorbing material was applied as an inside lining of the power-plant box and, in addition, sound-insulated ducts were applied for the incoming ventilating air and for the outgoing air. This was a fairly good solution but it was then believed that the remaining noise and some vibration were largely contributed by the metallic connection of the power-plant box to the car. The next step was to apply rubber supporting mounts between the box and the car. This step was justified, because subsequent observations indicate that noise and vibration are barely perceptible inside the car with the power plant running and the car at a standstill. With the car in motion, the power plant cannot be heard.

After it was found desirable to apply rubber supports to the power-plant box, the question arose whether flexible mounts would then be needed between the power plant and the box. Comparative tests were made, and it was found that, with rubber mounts on the box, flexible mounts between the power plant and the box were no longer necessary.

Critical Vibrations. The possibility of critical vibrations set up within the power plant, due to the mass elastic characteristics of the engine and generator coupled together, were calculated by the engine builder, and it appeared there might be an undesirable condition at the exciter end of the generator. Torsiograph tests were conducted on the completed power plant operating at steady-state load conditions, from which it was learned that the anticipated condition did not exist. Investigation revealed the fact that the exciter connection to the shaft was more rigid than had been anticipated.

Next we were concerned as to whether resonant conditions would be set up from electrical disturbances when the power plant was thrown on a 60-cycle 3-phase bus, and if a single-phase short-circuit load should occur. These conditions were investigated using an electrical pickup type of torsiograph which gave an oscillograph record. It was also possible to obtain recordings at both ends of the power plant simultaneously. To simulate what we considered the worst condition, the power plant was operated at 62 cycles, no load, and then thrown 180 deg out of phase onto a 60-cycle, powerhouse bus. It was observed that the engine quivered a few seconds before settling down to a steady-state normal running condition. An analysis of the oscillograms indicated that there was little, if any, pole slippage during synchronization. The disturbances noticed were due to the alternator rocking back and forth within one pole arc until the engine governor could get control of the initial disturbance and promote constant power loading. No serious disturbances were found.

Service and Maintenance. Due to the nature of the application of a power plant underneath a car, it is immediately apparent that inherent difficulties exist in obtaining adequate accessibility for service and maintenance. In order to solve this problem, a design was used wherein the power plant may be swung out of its box on a pivot to allow free access. In this condition, a simple means is provided for releasing the power plant from its supports and applying a replacement. The power plant may be operated in the swung-out position.

To promote long periods of operation the engine builder has provided a larger than normal oil pan and a larger lubricating-oil filter. Nevertheless, such a power plant will require periodic inspection and maintenance, and the success of its application probably will depend in large measure upon how well the railroad forces service and maintain the equipment.

The Trans-Arabian Pipe Line

COMMENT BY WILLIAM G. HELTZEL[6]

By an intimate firsthand knowledge obtained through his treks across Arabia, the author[7] ably presents an interesting description of the country through which this pipe line passes. The interspersed interpretations, such as the explanation of the sand dunes, brighten and add interest to the paper. By both leadership and participation in the engineering investigations from the inception, the author is able to present an authentic report on the engineering and design of this unusual pipe line.

Never has such a large crude-oil pipe line, measured by length, diameter, and capacity, been built; and, consequently, there is no comparable precedent or experience that can be used for guidance. Never has a pipe line of this magnitude been built under such adverse conditions and circumstances. Thus the design and construction of this line have called for extensive investigations, new methods, and new ideas; much pioneering work has been done on this project.

In the scope of the paper, the author is able to present only the high lights of the project, which leaves an interesting story that should be told someday on the development of new methods for this job. The adoption of larger- and larger-diameter pipe has brought on new problems that were never encountered in the smaller lines. The "Big Inch" (24 in., laid in 1942) became a criterion for large-diameter crude-oil lines. Before that the prevailing large size was 12 in., and 16 in. was coming into use. The Big Inch was a sudden change; now comes another abrupt change in size of pipe used in the Trans-Arabian 30–31 in. pipe line. An increase of 14 to 18 in. diam of pipe within the brief period of 6 years—1941 to 1947, inclusive—has been somewhat of a shock to the art of pipe lining, and it has not allowed sufficient time to develop practices completely. This is one of the reasons why the problems on this job have been difficult and intense. In designing, planning, and constructing these large-diameter lines, there must be commensurate and concomitant growth in ideas, imagination, and foresight. Nevertheless, many new and unforeseen problems will be encountered in the construction and operation of these large-diameter lines, and probably much remains to be learned by experience.

The staff of the Trans-Arabian Pipe Line Company and the manufacturers of various equipment deserve much credit for such developments as the sky-hook, the large-capacity desert trucks and pipe trailers, large machines for cleaning the pipe and applying the protective coating, the automatic welding and triple ending plant in Arabia, the protective pad for under the pipe, the large volume high-head centrifugal pumps, and other developments of lesser interest. In general, the results so far in the use of these new developments are reported to be favorable.

One of the problems in constructing these large-diameter lines is bending the pipe to change the course of the line or both horizontally and vertically to fit the pipe to the ground. Since it is most practicable to bend the pipe cold, this operation becomes a difficult problem for $\frac{1}{4}$-in. wall, 30 and 31-in. prestressed pipe. It will be of interest if the author would add to his paper a comment on the bending and what methods were finally decided upon for the Trans-Arabian line.

After a second reading of the paper the writer has not found any reference to the length of the joints of pipe or the reconditioning and automatic welding

[6] Consulting Engineer, Tulsa, Okla.

[7] "Design Features of the Trans-Arabian Pipe Line," by S. P. Johnson, MECHANICAL ENGINEERING, vol. 71, October, 1949, pp. 821–825.

plant at the reception point in Arabia for repairing damaged pipe and for welding the pipe into longer lengths before it is hauled to the pipe-line right of way. It is his understanding that the pipe is received in standard 30-ft lengths, that the pipe is then welded into 90-ft sections and transported over desert roads by special trucks and trailers to the pipe-line right of way, part of which is many miles from the reception point. This operation is such an important link in the plans for the construction that a brief reference to it by the author will be useful information. What has been the nature and the amount of the damage to the pipe in transit from the United States? What is the tonnage hauled by the large trucks? What has been the average rate of travel for the trucks? What has been the life of the equipment? What is the production in the welding yard?

Since a substantial amount of this line has been laid on the east end, the reader will find interest in a statement from the author concerning the average progress in the construction of the line.

In addition to the excessive cost of blasting a large ditch through solid limestone, were not the corrosive nature of the rock and the difficulty of maintaining such a large-diameter line in a deep rocky ditch other considerations in deciding on the use of the above-ground line where the conditions required this type of construction?

Concerning the restrained pipe line, the author has reported some unexpected and unexplained occurrences in the first 40 miles of the line. Apparently the mechanics of the system is not too well known, and probably other unpredictable things will happen. One would expect that anything on the face of Arabia suffers the deteriorating effects of the severe elements of nature. The exterior wall of the pipe above ground may be subjected to considerable erosion. In due course of time there may be considerable deterioration in the anchors and supports. The writer would expect the above-ground line to require a large amount of maintenance, when viewed over a long period. Because of the uncertainties in this type of construction, presumably it will be used only where it is a necessity. Mention is made in the paper about various methods that have been tried in above-ground construction. Under some conditions, such as in the case of some large lines laid above ground in Venezuela, it is practicable to allow the lines to lie on the ground without any provision for restraining their movements, but it is the writer's opinion that lines of such sizes as 30 and 31 in. cannot be laid in a random fashion on hard, rocky ground; they must be supported, and their movement must be controlled. It is generally known that the use of expansion joints is impracticable.

The author has mentioned the very interesting phenomenon of expansion and contraction of oil that was observed in the Canol line due to changes in temperatures. More recently this same phenomenon was observed in the operations of a long 6 and 4-in. above-ground line that was laid in the Andes of Bolivia. As the author reports, the operations are affected by this phenomenon. Due consideration should be given to it and other factors of probably equal importance when it is planned to place the line above ground, because it is believed, as does the author, that this effect is not appreciated fully.

With respect to the "closed system," I prefer at least one tank at a pumping station so that an open or regulated suction pressure system can be used instead of a tightly closed system from the beginning to the end of the line. We have much to learn about the operation of these large-diameter lines, particularly with respect to shock and water hammer. It is believed that the risk of damage from these phenomena is greater in a closed system. Since these effects undoubtedly have been absorbed in the large safety factor of smaller lines, we may not be fully aware of the hazard in the large lines.

Concerning the hydraulics, the writer believes, as the author does, that in these large lines operating near their capacity the friction factor is no higher than for smooth pipe. It has been my experience in the design and operation of many miles of crude-oil lines that for 10-in. pipe or larger, when operating near normal capacities, the coefficients of friction fall close to the Stanton-Pannell curve. As a practical procedure he has used the Stanton-Pannell curve in designing crude-oil lines in sizes of pipe from 10 in. up, and the results have been satisfactory.

There has been a trend in the use of centrifugal pumps for these large-capacity crude-oil pipe-line systems, using both electric motors and Diesel engines for driving the pumps. It started with the Big Inch (24 in.) that was built during the recent war. The reasons for the use of electric-motor centrifugal pumping units on the War Emergency Line are understandable, but it is not yet clear why this type of pumping has come into such extensive use for pumping units on the large-capacity crude-oil systems, because it lacks the flexibility needed in meeting the conditions under which a crude-oil pipe-line system must operate. The Diesel-engine drive improves this flexibility, but it is believed there is greater flexibility in the Diesel engine and reciprocating pump.

Some of the factors in favor of centrifugal pumping are as follows:

(*a*) Much lower first cost.
(*b*) Smaller plant.
(*c*) Less operating labor.
(*d*) Fewer auxiliaries.
(*e*) Less maintenance.
(*f*) Longer period to pay out greater investment in the Diesel-reciprocating plant.
(*g*) Stream free of pulsations.
(*h*) Little or no pressure surging in the pump and manifold discharge lines.
(*i*) Until recently reciprocating pipe-line pumps, suitable for these large-capacity systems, were not available.

Since a substantial amount of above-ground construction will be used, the possibility of pump pulsations in the line may have been a consideration also in deciding on the use of centrifugal pumps for the Trans-Arabian line.

However, in planning large-capacity systems the writer believes there are advantages in reciprocating pumps which should be weighed carefully.

The large reserves of petroleum in the Near East and the pipe lines that will be built in the Mediterranean may have considerable influence on the life and economy of the European nations. It is reasonable to believe that many pipe lines will be built in Europe for transporting the oil after it is received from the Near East and in due time for transporting petroleum products.

AUTHOR'S CLOSURE

Mr. Heltzel's kind comments raise several questions not answered in the original paper. Some of the answers follow:

After rather careful consideration, it was originally decided to use prefabricated bends for those portions of the pipe line laid above ground and wrinkle bends for the buried portions. The specifications for wrinkle bending called for 2-deg wrinkles at approximately 3-ft intervals.

A considerable time after construction had commenced, a hydraulic machine for stretch-bending thin-wall 30-in. and 31-in. pipe was developed. These stretch-bends will be used instead of wrinkles for the remainder of the project.

The pipe joints average 31.3 ft in length and, after being triple-jointed at the terminal, are hauled to the right-of-way in lengths averaging almost 94 ft. Approximately 5 per cent of the joints are damaged in transit. As might be

expected, the damage is largely dented ends which are repaired readily by the use of internal expanding clamps and sledge hammers.

Over 100 heavy trucks have been in operation hauling the pipe along the right of way, as well as material for pumping stations. Net loads vary from 27 to 35 tons, and average speeds are 10 to 11 mph. Wear and tear of the trucks and in fact all the construction material has been very severe because of the heat, sand and dust, as well as the inexperience of the Arab drivers. However, conditions are now improving, and there is no doubt the equipment will outlive the construction period (probably $3^1/_2$ years total), although with very heavy maintenance.

The production rate of the automatic welding machine used for triple-jointing the lengths at the Ras Misha'ab Terminal was 57.8 miles in November, 1949, with a peak rate of 17 welds per hr. The average laying rate between March, 1948, and August, 1949, was 18 miles per calendar month, with one construction spread laying line both above ground and buried. During November and December, 1949, the progress averaged 54.3 miles per calendar month, with one spread laying line mostly above ground.

SIDNEY P. JOHNSON.[8]

[8] Engineer, Standard Oil Company of California, San Francisco, Calif.

Developments in Burning Wet Wood

COMMENT BY J. S. ABEL[9]

This subject has been treated in a timely and interesting manner by Mr. Otto de Lorenzi.[10] To those in the lumber-manufacturing business the matter is increasingly important. Within the last several years we have seen a continued rise in the cost of hogged fuel. Waste from saw mills which once went to the burners is, in the larger mills, converted into the raw materials for salable commodities. For example, bark is now being made commercially into a number of items and, with the whole log barked before sawing, slabs which once had no value other than fuel or became burner refuse when there was an excess of fuel, can now go directly into a chip plant to be processed for pulp or fiberboard. Saw mills integrated with other plants for more economical utilization of the whole log are in some cases forced to supplement the dwindling supply of hogged fuel with oil. In such plants little waste remains for fuel except the sawdust and shavings.

The changed conditions of the past few years have made it necessary in many cases to install auxiliary oil firing. The trend in the design of new power plants in this industry is for stations of higher pressure with combustion control and modern fuel-saving auxiliaries with dutch ovens designed for oil fuel as well as hogged fuel.

The common method of feeding hogged fuel is by dropping it into a Dutch oven from above by gravity, the material forming a cone on the grate surface below. The objections to this procedure are that the wet fuel is constantly being dropped on the burning surface of the cone and carry-over of the lighter particles picked up by the hot gases is considerable. Those particles not burned in the Dutch oven or in the combustion chamber are carried up the stack. Combustion control is hard to maintain with an open feed hole and, consequently, there is a loss of efficiency with this method of firing.

The main objection from the operator's standpoint with either spreader stoker or underfeed firing is the necessity of chipping the wood in order to obtain a product which can be fed at a rapid uniform rate. Considerable difficulty and expense would be involved in chipping the average saw-mill waste. Material for chipping must be selected for size and fed into chippers in such a way that the knives cut the wood at the same angle in order to produce chips of uniform size. Mill waste consisting of trimmed ends, split pieces and edgings would offer difficulties at the chippers.

Another problem would be met with in burning the sawdust. A large portion of the waste is straight sawdust which cannot be burned alone. A similar problem would be met with planer-mill shavings. These might perhaps be mixed with the chips just before these enter the stoker and they might be kicked into the furnace along with the latter.

There is no doubt that the rising cost of oil and the growing scarcity of hogged fuel will demand greater economy than that obtained with the present Dutch ovens. It would appear that the spreader-type stoker offers possibilities, providing the requirements as to sizing the fuel do not present too much of a handicap; also, that the stoker can handle sawdust and dry planer-mill shavings and introduce them into the furnace so that they may be burned without the major portion going up the stack. With the underfeed stoker, difficulties will be encountered in introducing this fuel into the furnace to obtain even burning in all parts of the fuel pile.

COMMENT BY H. W. BEECHER[11]

The author has furnished a very interesting paper on some of the recent advances in the art of burning wet wood waste. Certain operating capacity ranges have been given for the various installations. Manifestly, the modern types of unit as illustrated in Figs. 3, 4, 6, and 7, of the paper all incorporate an air preheater and of necessity forced-draft fans.

It would be interesting to learn whether the capacities indicated for the boilers shown in Figs. 1 and 2 are based on (*a*) preheated air, (*b*) controlled air supply, such as obtainable with forced draft.

With units of the type illustrated in Figs. 1 and 2, and without forced draft, negative pressure throughout the setting must prevail, drawing air through the ash pits and through the grates to provide the air necessary to burn the fixed carbon in the fuel. Such negative pressure in the furnace also draws in large quantities of air with the fuel. It is thus impossible to obtain a proper distribution of air to permit either maximum capacity or maximum efficiency.

With prevailing high costs of all fuels, high-moisture wood waste should always be burned with controlled supply of preheated air.

The high percentage of oxygen in wood means high CO_2 for perfect combustion. Relatively high CO_2, compared to other fuels, will result for any stated excess air.

The author cites spreader-stoker installations using wood refuse. It apparently has been possible to utilize continuous-ash-discharge spreader stokers with refuse when (*a*) the refuse is specially sized so that there are no particular feed problems; and (*b*) the refuse contains sufficient dirt and other extraneous material so that a protective layer covers the grates and thus protects them from destruction by radiant heat from the combustion space above.

In most installations in the Northwest, difficulty would arise in using spreader stokers because of the extra cost to size fuels properly and, further because of the lack of protection of grate surface against radiation.

The spreader-type stoker is subject to the same objection as the cell-type furnace, namely, that the green fuel falls as a blanket over the surface and, there-

[9] Chief Engineer, Weyerhaeuser Timber Company, Tacoma, Wash.

[10] "Some Recent Developments in Burning Wet Wood," by Otto de Lorenzi, MECHANICAL ENGINEERING, September, 1949, vol. 71, pp. 735–738.

[11] Consulting Engineer, Seattle, Wash.

fore, slows up the distillation of moisture and volatiles from the fuel. Some opposition to spreader stokers for this service has been cited because of the comparatively small storage of fuel in the furnace.

It should be remembered that less than 20 per cent of the dry-fuel weight is fixed carbon. This means that over two thirds of this heating value is in the volatiles.

The discusser's conception of furnace requirements for the burning of wet refuse is as follows:

1 Large area of fuel exposed to furnace temperatures to effect (*a*) evaporation of moisture in fuel; (*b*) distillation of volatiles from fuel.

2 A zone in which the wet fuel enters the furnace and does not cover the fuel previously deposited in the furnace but rather gradually moves into a zone of fixed carbon without volatiles as the moisture and volatiles are driven off leaving fixed carbon.

3 Separately directed overdraft air that will create turbulence and mix intimately with the volatiles as they are driven from the fuel.

4 A preheated air supply that will be forced through the bed of incandescent carbon at rates required to reduce the supply continually, converting it to a mixture of CO and CO_2, which in turn will be converted to CO_2 in the combustion chamber above the fuel bed by the admission of suitable supply of overdraft air.

The discusser has been working on the development of such a furnace for more than a year, and the first installation should be in service by the end of 1949. In this particular installation, the foregoing results are accomplished by the introduction of the fuel at the upper end of an inclined hearth from sealed bins. The fuel cataracts down the hearth continually, moving from a zone in which distillation is taking place to one in which the incandescent carbon is being consumed. The hearth consists of closely spaced boiler tubes between headers and forming a part of the boiler surface. High temperature preheated air is admitted in plenums or zones underneath the hearth. The supply of air to each section is controlled so as to obtain necessary division of air to accomplish the aforesaid requirements.

COMMENT BY B. J. CROSS[12]

The author has described and illustrated several arrangements for the burning of waste-wood refuse for the generation of steam. He has classified these broadly as single-stage and two-stage furnaces.

The two-stage furnaces consists of a low Dutch oven into which the fuel is introduced, and a secondary chamber under the boiler in which the combustion is completed. The fuel is usually supplied from a conveyer system and is fed intermittently through openings in the top of the Dutch oven. It forms a conical pile which takes up a large part of the volume of the primary chamber which is in effect a gas producer. The most active area for combustion is at the periphery of the cone where the grates are not too thickly covered. The flames from this active area wipe up the sides of the cone and serve to dry and ignite the wood as it moves to the edges of the pile.

The refractory walls and arch of the Dutch oven provide a heat reservoir to even out temperature waves that may result from intermittent feed or from changes in moisture content of the fuel.

The Dutch-oven furnace has had wide application in the wood industry. It is economical of equipment, needs but simple instrumentation, and does not require a high degree of skill of operation. Where wood wastes present a problem of both disposal and utilization, this method of burning is justified and no doubt will continue to be used where this condition prevails.

However, it is becoming a growing practice to utilize more of the log in the manufacture of marketable products. This both increases the power requirements and reduces the amount of by-product fuel. It may then be necessary to purchase more expensive supplementary fuel. In this situation a Btu in wood refuse is worth almost, if not quite as much, as a Btu in coal or oil, and any possible increase in the efficiency of combustion and power generation is an important consideration.

The principal feature of the single-stage design, as described by the author, is the flat and thinner fuel bed. This requires that the fuel be fed continuously at a rate equal to the burning rate.

The advantages of these later designs are a higher burning rate per square foot of grate or per foot of furnace width, and a controlled air supply which permits a low excess air that may be maintained, automatically if desired, over a wide range of load.

The higher burning rate permits the use of narrower and less expensive boilers. The lower excess air results in higher efficiency. Because of lower gas volumes, this reduces the size and cost of secondary heat-absorbing surface such as economizers and air heaters.

With the thinner fuel bed there is, of course, no large reserve of fuel in the furnace, and feeding mechanism must be provided to supply fuel continuously to the furnace. Auxiliary power may be higher and must be justified by higher efficiency and lower maintenance.

COMMENT BY P. B. PLACE[13]

In the successful burning of wet wood wastes, one of the most important factors is the control of the air supply. Not only must the total air supply be kept under control in order to maintain maximum CO_2 and furnace temperature, but the relative amounts of underfire and overfire air should be regulated carefully.

Although, theoretically, the amount of underfire air is relatively low, in practice this air supply should be fairly high and probably over 50 per cent of the total air supply. Its function is not only to provide air for primary combustion but also to provide a carrier to sweep the steam and distillation products out of the fuel bed. Because the wet fuel bed offers considerable resistance to flow, undergrate pressures have to be relatively high and the grate opening has to be relatively small, with maximum flow areas under the deepest sections of the fuel bed. With high undergrate-air pressures, there must be minimum leakage areas around the grate edges.

In the experimental installation mentioned in the paper, in which a number of different types of wet wood fuel were burned, only slightly preheated air was used. In burning the $66^1/_2$ per cent moisture pine chips given in Table 1 of the paper, a brief description of the furnace conditions may be of interest. Viewed from above, the fuel bed was almost completely blanketed by the cloud of steam liberated by combustion, and the principal evidence of combustion was the rate of fuel feed together with analysis of the combustion gases.

With this very high-moisture-content wood, control of underfire and overfire air was important, and an excess of overfire air would soon kill active combustion. Any tendency toward reduced combustion could, however, be overcome quickly by reducing overfire-air and increasing underfire-air supply.

In one phase of the tests, the fuel feed was stopped to allow the fuel bed to burn down almost to the bare grate and then quickly accelerated to full rate of fuel feed. By careful regulation of air sup-

[12] Manager, Development and Research Department, Combustion Engineering-Superheater, Inc., New York, N. Y. Mem. ASME.

[13] Research and Development Engineer, Combustion Engineering-Superheater, Inc., New York, N. Y. Mem. ASME.

ply, full combustion rate could be reattained with minimum of smoking and without losing the fire completely.

In these tests in the the experimental furnace, little dependence was placed on radiant heat from brick walls. The limited duration of the tests and the high moisture content of the fuel did not allow the walls to become hot enough to be of any value as a radiant surface, and it may be assumed that the combustion rates attained were entirely self-supporting and could be maintained in a water-cooled furnace.

AUTHOR'S CLOSURE

The author wishes to express his appreciation and thanks to those who have prepared written discussions and also to those who contributed to the questions from the floor.

The continuing interest in the subject matter is an indication that improved methods for burning wet wood are being eagerly sought after. Several installations, incorporating many of the new design features discussed, have been purchased recently and when these go into operation much valuable data will become available for future improvement of the art.

In Mr. Abel's discussion he points out several features of the spreader-fired single-stage furnace that may be objectionable from the operator's standpoint. The first is the necessity for sizing the wood. Actually this is not quite as serious as it may appear. With a properly maintained hogger or chipper, from 80 to 90 per cent of the resultant product may be fired directly without further processing by simply passing it through a bar-type screen. The "oversize" is then rehogged. For existing installations this may require some rearrangement of the conveyer system. The manner in which the combustion process functions in the single-stage high-set-spreader design, will overcome most of the difficulties encountered where straight sawdust or planer-mill shavings are used. The highly turbulent suspension-burning zones retain the ignited fuel in the furnace for a relatively long time so that the combustion process is completed and only a relatively small percentage of char finds its way into the boiler and gas-duct system.

Mr. Beecher asks concerning the capacities of the units, Figs. 1 and 2. Fig. 1 has a forced-draft fan to supply preheated air. Fig. 2 is of the natural-draft type using air at room temperature. For the spreader-fired experimental unit a continuous-discharge type of grate was used to save labor, because the spent wood fuel contained a high percentage of sand. This type of construction is not required where low-ash-content wood is burned, as the refuse is allowed to accumulate on the grate and is only removed when its thickness interferes with the flow of air. This method of operation is possible because most of the burning occurs in the furnace cavity, above the grate, and there is no piling or blanketing of the fuel bed with wet wood. The single-stage furnace thus meets Mr. Beecher's requirements of: a flash-drying zone in which moisture is almost instantly driven off; a turbulent burning zone, using easily controlled amounts of highly preheated air, for volatile matter distillation and burning; and an active thin fuel bed of incandescent carbon also supplied with a controllable quantity of preheated air.

Messrs. Cross and Place have presented additional valuable information in connection with design and actual operation of single-stage furnaces which accents their advantages as compared with the older two-stage type.

OTTO DE LORENZI.[14]

[14] Director of Education, Combustion Engineering-Superheater, Inc., New York, N. Y. Fellow ASME.

Instrumentation for an Atomic Power Plant

COMMENT BY V. L. PARSEGIAN[15]

Messrs. Cochran and Hansen[16] have done well to focus attention on the very difficult problem of providing proper instruments for the atomic power plant. Such plants are likely to be successful only to the degree that they are made automatically controlled and continuous in operation over extended periods—both of which characteristics depend heavily on the availability of suitable instruments. The same holds true for the radiochemical separation plants which are associated with these power units.

Perhaps a somewhat different emphasis may be made as to the characteristics desired of the new instruments. Most instrument systems may be divided into a detector element, a "telemetering system," and the indicating or registering instrument. If a control function is also involved, one may further identify a controller element associated with the instrument, the controlled valve or motor operator, with again a telemetering system connecting the two. Whether the measurement is of radiation intensity, temperature, pressure, liquid level, flow rate, or the position of a mechanical element, the information must often be relayed from an uninhabitable radive[17] area to an instrument-panel area where operators may remain without danger, the two areas being separated by heavy walls.

Therefore, instrumental methods used in atomic plants are likely to require faithful telemetering of intelligence from a detector element to an indicating or recording instrument which often is hundreds of feet away.

Telemetering Medium. The telemetering medium must not permit transport of radioactive fluids, vapors, or air from the danger areas to the instrument panels either during normal operation or on breakdown. Most mechanical couplings are likely to have wall clearances which will be difficult to seal against air leakage.

When pneumatic or hydraulic systems are used, the fluid should not under any likely circumstance be permitted to flow or return to the instrument area. This would seem to make of questionable merit a device such as the single thin diaphragm air-balance method mentioned by the authors for the measurement of pressure. By way of illustration, the method might be improved to permit greater safety by using a multiplicity of intervening chambers and diaphragms, each sealed and perhaps filled with liquid. The diaphragms could be connected mechanically at their centers to transmit small movements, and perhaps varied in diameter to assure that failure of the first diaphragm is readily detected.

In connection with pneumatic systems, it may be well to point out that unless the rate of air flow is sufficiently high, there is danger of radioactive vapors working back into the instrument-panel area by slow diffusion processes, particularly if the air is supplied through large-diameter lines and at a "trickle" rate. Usually there should be provided a separating medium of sufficient dependability to prevent flow back to the instrument areas; obviously, one cannot depend upon any check-valve system for such separation.

[15] The Kellex Corporation, New York, N. Y.

[16] "Some Instrumentation Requirements in an Atomic Power Plant," by D. Cochran and C. A. Hansen, Jr., MECHANICAL ENGINEERING, vol. 71, October, 1949, pp. 808-810 and 820.

[17] The term "radive" has been proposed by W. B. Snow of The Kellex Corporation, to indicate the presence of nuclear radiation above tolerance level. Possibly this new term can substitute for the less desirable expression "hot" which is becoming all too common and confusing in the conversation of the nuclear engineer.

From the point of view of providing complete separation against radioactivity transfer between plant areas, electrical telemetering methods possess important advantages. Therefore considerable effort should be exerted toward developing electrically registering instrument systems.

Detector Elements. The most serious instrumental problems encountered are usually in connection with the detector elements, since standard industrial recorders will perform fairly well in recording either electric voltage or pneumatic-pressure changes. Aside from the usual requirements of sensitivity, range, stability over extended periods, and the like, a feature that is highly desired in a detector system is nicely exemplified in the electromagnetic flowmeter mentioned by the authors. The fact that this instrument will measure flow rate without direct contact between the detector element and the stream will go far toward offsetting other limitations the method may have. Failure of such an instrument will not require that the plant be shut down, and the pipes dissembled by complicated remote-control mechanisms for replacement of the element.

This same characteristic would be welcomed in instruments to measure liquid level, temperature, chemical composition, position of moving levers, etc. In addition to electromagnetic induction, one might make use of the magnetic or dielectric properties of the contained fluid, electrical conductivity, or of selective absorption by the fluid for radiation that can penetrate pipe walls. Since the pipe walls may often be made of insulating or nonmagnetic materials, or even of plastics in low-temperature systems, one may utilize nuclear radiation or high-frequency electromagnetic phenomena in addition to ordinary frequencies.

In general, one should stress the importance of developing detector systems that:

1 Do not require direct contact with the fluid or other element under measurement, but rather permit separation of the detector by walls of substantial strength.

2 Permit some measure of periodic standardization or checking from the instrument panel.

3 Require no mechanically moving parts in the radive[17] fluid stream.

4 Permit replacement without intricate manipulation and without serious loss of calibration.

5 Have time constants of the order of seconds when chemical process or heat transfer are involved, but nearer 0.001 sec when emergency control of an atomic reactor is involved.

6 Offer large range; as pointed out by the authors, the ratio of maximum to minimum readings may sometimes reach a factor of 10^7, although for such extreme ranges it would be better to have multiple detector units. Possibly a logarithmic scale may also find useful application, since one is usually more concerned with percentage change than with increments of change.

7 Long life is of great importance, as pointed out by the authors. Perhaps a "guaranteed" life of 10 years for instruments which cannot be replaced easily, and 2 years for more easily replaceable units, may provide useful guides comparable to the best of present industrial practices.

8 One can tolerate considerable complexity in the instrument components, provided the complexity is kept at the instrument panel and not at the detector end. The engineering design of such instruments should make possible quick replacement and interchangeability of component subassemblies. The detector unit should also, in general, be a "packaged" unit.

It may be well to emphasize that successful process control has been attained in industry by relying less on absolute accuracy than upon reproducibility, uniformity, and sensitivity of instrumental measurements.

Radiation Measurement. The presence of nuclear radiation in atomic plants presents both a problem and an additional tool; for there is not likely to be a better indicator for the presence (or variation) of radioactivity in a solution than is the measurement of the emitted radiation. Radiation-measuring instruments unfortunately leave much to be desired in so far as their present applicability to process plants is concerned, largely because they have not been engineered for performance under industrial-plant conditions. Most manufacturers of radiation-measuring instruments have tended to concentrate on laboratory-type instruments, perhaps because sufficient emphasis has not yet been placed upon instruments which are suited to the vapors and vicissitudes of plant use.

Much remains to be done in this field, and the quality of the results will be as much dependent upon the work of the industrial-plant engineer as it is upon the research of the nuclear physicist.

Preserving Liberty

COMMENT BY CARROLL D. BILLMYER[18]

In commenting on the excellent paper[19] by W. C. Beekley, I wish to lend whatever support I can to this very important and urgent cause. I have no desire to whip up an anticommunist or anti-socialist hysteria. My experience in industry and in education over the last thirty-five years has indicated clearly the gradual deterioration of which the author ably writes.

As he so accurately states, thinking is everybody's business; however, as we engineers are guilty of relieving our fellow citizens of the necessity for much thinking about the routine operations required for life, we should become more aggressive in stimulating thought about our social problems. It is one of the fundamental principles of the common law that for every right there is a corresponding duty.

The right of free speech and assembly is inseparable from the duty to present the truth concerning the other side of the argument. The failure to perform a duty to our fellow man constitutes the sort of negligence recognized at law.

The growth of engineering has depended upon the free interchange of information in societies such as this. Why restrict our energies to technical matters alone? Is not our function to adapt findings of physical science for the benefit of mankind?

I have had enough experience with the American workman to know that he can be led by one who has demonstrated his fitness to lead. On the other hand he resents being pushed around. My own experience has amply demonstrated his intense desire to know "what the score is," particularly if he can turn to one whom he trusts. If we fail to supply the leadership, is he to be blamed for listening to "crack-pots" who will gladly lead him down to the chaotic existence from which there is no easy return.

This is why, for the past twenty years, I have tried to sell the desire to understand the situation to my senior students. Not only do they have the personal responsibility to see that their men are properly cared for; but they will be the greatest sufferers from a failure of our free-enterprise system.

Every engineer who is a minor execu-

[18] Professional Engineer, Kingston, R. I. Mem. ASME.

[19] "Preserving Liberty," by W. C. Beekley, MECHANICAL ENGINEERING, vol. 71, September, 1949, pp. 733–734 and 738.

tive should keep the welfare of his men in view. It is his duty to defend them and to give them due warning of impending changes.

Great credit must be given Mr. Faville of our Civic Responsibilities Committee. This does not relieve a single one of us from his own individual duty to fight for freedom.

The point I would like to make is that this is an individual duty or responsibility which each must assume. We must not wait for a directive from above or we shall wake up some bright morning and find ourselves in "planned chaos." We shall have no one to blame but ourselves.

Of course the easier path is to sit with our feet under our desks and do nothing. That is no defense at all, as our best military minds know.

I firmly believe that error cannot live in the searching light of truth. It is our duty first to inform ourselves and then to inform others. This job must be begun now—not next year—and we are the ones elected to do it.

AUTHOR'S CLOSURE

Mr. Billmyer has contributed a very constructive comment. He emphasizes most clearly the particular responsibility of each individual engineer and very properly lays stress on a point which the author did not cover at all, that is, the importance of bringing the fundamentals of this matter to the attention of the younger men, particularly the engineers, during their periods of formal education. It is indeed encouraging to know that the writer is actually working at this.

One of the phases of this matter which most seriously concerns the author is the fact that the significant amount of really excellent and thoughtful discussion, which is being published on this subject, is not, in general, being made available to those who need it most. Wider and more precisely aimed distribution of these thought-provoking discussions is desperately needed. If brought to the attention now of the young engineers in the process of formal education, and in the early years of their industrial training, we can conceivably have, within a year or two, some thousands, at least, of able and alert young men impressed with the importance of this matter and thinking clearly about it.

The possibilities of the good which they can do, in spreading the message further, are tremendous. They constitute perhaps the most important audience for us to reach immediately in order that, by means of their efforts, we may most quickly reach the much wider audience of those who apparently are being led rapidly down the path from which there is no quick and perhaps no possible return.

W. C. BEEKLEY.[20]

[20] The Whitlock Manufacturing Company, Hartford, Conn. Mem., ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Tool Engineers Handbook

TOOL ENGINEERS HANDBOOK. By American Society of Tool Engineers Handbook Committee. McGraw-Hill Book Company, Inc., New York, N. Y., Toronto, Can., London, England, 1949. Cloth, 5¾ × 9 in., tables, figures, ix and 2070 pp., $15.

REVIEWED BY J. E. GILKEY[1]

FOR many years engineers in the mechanical manufacturing industries have felt the need for a reference book in their field to fill the gap between the existing machinists and mechanical-engineers handbooks. The Tool Engineers Handbook appears to satisfy this need. There are twelve sections devoted to the problems of management, seventy-six sections devoted to manufacturing processes, seven sections on inspection, and nineteen sections on the design of tools and machine elements. A thorough general index is provided and a bibliography follows each article.

The stimulus of war brought many new processes into general use. Overexpansion and increasing competition have added to the problems of management in the mechanical processing industries. The requirements upon management as well as the tool engineer demand a reference book that is comprehensive and up to date.

The American Society of Tool Engineers recognizing this need, interviewed hundreds of executives, engineers, educators, librarians, and surveyed the views of its many members to determine its scope and content.

The material was written by 152 authors. All are recognized authorities in their fields of specialization. The general aim was to cover every subject presented so thoroughly that future expansion and revisions would not be necessary for many years.

The first section shows the rapid development of the requirements of the tool engineer from those of a skilled technician to the professional status of an engineer. He must produce an article which is not only mechanically sound, but will meet the tests of salability. It must appeal to the market and produce a profit. Consequently, he is interested in product development which is outlined in Section 2.

Making a profit depends not only on the salability of an article, but on the efficiency of operation of the physical plant. Section 3 covers the determination of methods and processes, economic selection of new equipment, and improvement of existing techniques. Sketches, graphs, and mathematics are used to explain the examples chosen.

Sections 4 and 5 cover production analysis, cost estimating, job planning, and controls with examples illustrating policy, organization, and sample forms. This is of interest to the tool engineer not only as a guide to the operation of his own department, but also because of his vital part in all of this work either as an executive or a technical consultant.

Quality control is one goal of the tooling and is therefore covered in Section 6. This application of statistical methods should be absorbed by every designer responsible for limit dimensions. With quality charts available on all the machines in his plant, he is able to determine with an unusual clarity the difficulties he is imposing by close limits and also the value of holding or relaxing those limits.

Time and motion study invariably results in changes that require a tool

[1] Instructor in machine design, department of mechanical engineering, Case Institute of Technology, Cleveland, Ohio.

engineer's assistance. These principles are discussed in Section 7.

The remainder of the Handbook is of more obvious use and perhaps it would be wise to list a few of the plant personnel who will be reaching for the book and the reason why.

I *The Tool-Design Draftsman*

(*a*) Standard drafting-room practice to find the rectangular dimensions for "13 holes evenly spaced."

(*b*) Circle chart of 12 groups of tool steels arranged in order of characteristics of toughness, water, oil or air hardening, high-temperature resistance, and wear resistance, to choose a steel for a redesign of a part that failed.

(*c*) Table of spot-face sizes and wrench clearances.

(*d*) Table of allowances for bends in sheet metal.

(*e*) Table of formulas for 3 wire measurements of threads.

(*f*) Chart for determining shank sizes and overhang for tipped cutting tools.

II *Tool-Design Layout Man*

(*a*) Article on how design affects heat-treatment.

(*b*) Hundreds of illustrations of setups for difficult operations.

(*c*) Design of special cutting tools such as an end cutting reamer which cuts to the center.

(*d*) Tapers, spindle noses, and arbors.

III *Chief Tool Designer*

(*a*) Static and dynamic properties of metals.

(*b*) Tool forces, power consumption.

(*c*) Use of illustrations for training inexperienced men—such as the section on jigs and fixtures.

(*d*) Applications of electronic control devices to vary feed to suit variable depths of cut.

IV *Tool Supervisor*

(*a*) Estimating procedures—cost analysis—methods and sample forms.

(*b*) Scheduling methods and forms.

(*c*) Tool procurement and stocking systems.

(*d*) Mathematical analysis for equipment selection.

V *Machine Designer*

(*a*) Materials, for example, (1) Plastics, (2) Characteristics of types of synthetic rubber with respect to electrical resistance, impermeability to gas and water.

(*b*) Digest of physics and mechanics formulas with definitions.

(*c*) Design of such machine elements as springs, gears, ball bearing applications, and sleeve bearings.

VI *Machine Shop Supervisor*

(*a*) Time study methods.

(*b*) Plant layout.

(*c*) Materials handling and storage.

(*d*) Surface cleaning and protective finishing.

(*e*) Inspection equipment, methods.

VII *Machine Shop Foreman*

(*a*) Feeds and speeds.

(*b*) Charts of toolholders and setups.

(*c*) Cutting fluids.

(*d*) Machining characteristics of plastics.

Ship Tank Superintendents Conference

FIFTH INTERNATIONAL CONFERENCE OF SHIP TANK SUPERINTENDENTS: Papers and Discussions. London, Sept. 14–18, 1948. Edited by G. Hughes. Department of Scientific and Industrial Research and the National Physical Laboratory, 1949. Paper, 6 × 9¾ in., figures, diagrams, plates, xiii and 116 pp., 7s 6d. Apply His Majesty's Stationery Office, York House, Kingsway, London, W.C.2, England.

REVIEWED BY J. THOMAS TOTHILL[2]

IN September, 1948, the towing tank directors of Europe resumed their prewar custom of holding a conference every two years to compare notes and to standardize practices. Hitherto, there had never been American representation at these conferences; nor had European representatives taken part in the meetings of the American Towing Tank Conference. In 1948, however, a strong American delegation went to London. It included such well-known figures as Captain Harold E. Saunders, Dr. J. S. McNown, Dr. K. S. M. Davidson, Captain F. X. Forest, Dr. F. H. Todd, Mr. R. B. Couch, and Professor M. Hetenyi. This transatlantic co-operation will be further strengthened in 1951, when the Sixth International Conference will be held in the United States under the joint sponsorship of the A.T.T.C. and the Society of Naval Architects and Marine Engineers.

The 1948 technical discussions covered comparative tests of propellers in cavitation tunnels, the choice of suitable Reynolds numbers for propeller experiments, the use of turbulence-inducing devices in model experiments, and skin friction.

Notable results of the conference included: (1) a program to compare cavitation tunnels in different countries by testing a given set of propellers in each, (2) a general recognition that turbulence stimulation is necessary on all sizes of models, and (3) a general willingness to adopt a skin-friction formulation in line with modern theories of turbulence and supplanting the classical Froude values.

Interesting new developments in the technique of visualizing the extents of laminar and turbulent flow on models were described by British delegates W. G. A. Perring, A. G. Smith, and W. P. Walker. Mr. Couch of the American delegation presented the results of the A.T.T.C's Liberty Ship Series of models 7 ft to 30 ft long, tested in the American and Canadian tanks, which showed a fair correlation under conditions of stimulated turbulence.

Dr. J. F. Allan presented the results of the "Rome" Propeller Series, a set of eight propellers tested prewar in five different European tanks at the behest of the conference. They showed startling discrepancies, up to 15 per cent, between different tanks at the same Reynolds numbers on the same actual propellers. There was surprisingly little direct discussion of these results, but it is evident that attention will have to be focused on the causes of such discrepancies, and methods of eliminating them, particularly if the 1951 conference reveals similar discrepancies in the Cavitation Tunnel Series. Nevertheless, it is well that such matters should be brought out into the open for discussion, and this example illustrates one of the most useful purposes which the conference serves.

[2] Experimental Towing Tank, Stevens Institute of Technology, Hoboken, N. J.

Light Metals Industry

THE LIGHT METALS INDUSTRY: A Study of its Technological and Economic Development. By Winifred Lewis. Temple Press, Ltd., London, England, 1949. Cloth, 5¼ × 8½ in., illus., tables, charts, maps, schedules, xxix and 397 pp., 21/-.

REVIEWED BY F. C. FRARY[3]

THE author is at present information officer in the Intelligence Department of the British Aluminium Company, and has written this book after nearly twenty years of experience in the industry. The book presents the broad outlines of the growth and development of the aluminum industry, naturally from the British standpoint. The history of the development of the industry in different countries is well given, and there are extensive tables of metal production and consumption, prices, etc. Different producers designate their alloys by different names, and the list of such named alloys with

[3] Director, Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa.

their composition and source will be very useful to anyone who has occasion to read the foreign literature. The complete list of official (British) D.T.D. specification alloys and their composition contains information otherwise hard to find—in this country at least. Properties of various alloys and resistance to corrosion are also covered.

The treatment of fabrication processes and products is extensive, and largely from the point of view of the consumer rather than the producer. As stated in the introduction: "This book does not try to give an account so much of the processes involved as of special factors affecting the application of processes in themselves known—whose variety of forms, ancient and modern, is incidentally, astonishingly large—to aluminium and magnesium materials." The descriptive matter is clear and good; reflecting, of course, British practices, with some references (not always entirely correct) to American practice.

Chapters on postwar applications of aluminum and secondary aluminum smelting are followed by a section on magnesium, covering much the same field as that on aluminum. A brief chapter on beryllium concludes the book.

The book is very readable, well written and printed, and comprehensive. It will be of particular interest and value to those outside of the industry, because it gives the broad picture of the development and present status of the light-metal industries, unobscured by too many technical details which are primarily of interest to the specialist. As the author puts it: "This book does not therefore cover the technical ground of the main operational processes of the light-metals industry in any detail, but rather sets out from a different angle to view the industry of light metals from a technico-economic approach, attempting to relate it in perspective to the whole structure of modern industry, which has the great metal industries as its base." It is heartily commended to all interested in the industry from this viewpoint.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library 29 West 39th St., New York 18, N. Y.

Books Received in Library

ALUMINUM AND MAGNESIUM DESIGN AND FABRICATION. By R. B. Schulze. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1949. Cloth, 6 × 9¼ in., 589 pp., illus., diagrams, charts, tables, $7.50. This practical approach to light-metal product design and fabrication provides valuable data on aluminum and magnesium and discusses in detail the processing of these materials, manufacturing methods, and costs. In addition to the extensive coverage of forming operations, particular attention is paid to machining, to welded and bonded fastenings, and to finishing. Many photographs, sketches, and tables are included.

APPLIED MECHANICS. By A. P. Poorman. Fifth edition. McGraw-Hill Book Co., Inc., New York, N. Y., 1949. Cloth, 5½ × 8¼ in., 388 pp., diagrams, charts, tables, $4. This standard work on applied mechanics has been revised and brought up to date in this fifth edition. The law of Coriolis and a table of moments of inertia and radii of gyration of a number of simple areas are among the additions made. Loads on structures are now given in kips. The data of all problems are changed, and new problems are added. Answers to all problems are given.

CYLINDER PRESSURES AND THEIR INFLUENCE ON DIESEL ENGINE EFFICIENCY. By D. D. Cook, L. J. Grubb, and J. C. Lepic. Cooktite Ring Sales Company, 1737 Howard Ave., Chicago 26, Ill., 1949. Paper, 8¼ × 11 in., 87 pp., illus., diagrams, charts, tables, $2.50. This booklet discusses the specific factors which affect Diesel-engine cylinder pressures and methods for maintaining effective pressures. Instrumentation is described for determining pressure loss, and combustion data are given for a number of specific case histories.

ELEMENTARY STRESS ANALYSIS. By P. E. Soneson. Pitman Publishing Corporation, New York, N. Y.; Toronto, Canada; London, England, 1949. Linen, 6¼ × 9¼ in., 351 pp., illus., diagrams, charts, tables, $5. Intended as a text for courses in the analysis of statically determinate structures, this book applies the fundamentals of mechanics to the computation of the stresses in simple frameworks. Actual roof and bridge structures have been freely used as illustrative examples. Excerpts from American Railway Engineering Association and American Association of State Highway Officials specifications are included as well as material from other professional sources.

ELEMENTS OF THERMODYNAMICS AND HEAT TRANSFER. By E. F. Obert. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1949. Cloth, 6 × 9¼ in., 372 pp., illus., diagrams, charts, tables, $4.50. Based on the author's "Thermodynamics," this is a textbook for an undergraduate course in thermodynamics and heat transfer for students of engineering. The text stresses real machines, flow processes, properties of fluids, and the conditions where simplified analyses can be applied. Definitions are considered first and then the laws and applications. Problems are included at the end of each chapter, and the appendix includes much useful data.

ENGINEERS' DICTIONARY, SPANISH-ENGLISH AND ENGLISH-SPANISH. By L. A. Robb. Second edition. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1949. Cloth, 5½ × 8½ in., 664 pp., $12.50. This volume is designed to give the North American technical man the accepted engineering terminology of Spanish America and vice versa. The new edition has been enlarged: (1) to cover more thoroughly electrical and mechanical-engineering terminology, including radio and television; (2) to bring all branches of civil engineering up to date—particularly soil mechanics, photogrammetry, and airport construction; and (3) to include the important terms peculiar to mining, shipbuilding, logging, sugar milling, and oilfield operations.

GENERAL AND INDUSTRIAL MANAGEMENT. By H. Fayol. Translated from the French edition by C. Storrs, with a foreword by L. Urwick. Pitman Publishing Corporation, New York, N. Y.; Toronto, Canada; London, England, 1949. Linen, 5½ × 8¼ in., 110 pp., diagrams, charts, tables, $3.25. This is an English translation of a French book giving a scientific exposition of the general principles of management. It deals with the technique of industrial administration and industrial organization regardless of size. The emphasis is on the human aspect of administration in relation to the social group constituting the staff of the firm.

GIANT BRAINS OR MACHINES THAT THINK. By E. C. Berkeley. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1949. Cloth, 5½ × 8½ in., 270 pp., diagrams, tables, $4. Describing several existing large-scale mechanical computers, this book presents their general operating procedure, history and principles. Future possibilities and their significance are considered. The nature of language and of symbols, the meaning of thinking, the human brain and nervous system, and other allied topics are also included.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code may communicate with the Committee Secretary, ASME, 29 West 39th St., New York 18, N. Y.

The procedure of the Committee in handling the Cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are then sent by the Secretary of the Committee to all members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and is passed upon at a regular meeting.

This interpretation is submitted to the Board on Codes and Standards, as authorized by the Council of The American Society of Mechanical Engineers, for approval, after which it is issued to the inquirer and published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of December 16, 1949, and approved by the Board on Codes and Standards under the date of January 25, 1950.

CASE No. 897

(Reopened)

Make the following changes in paragraph 2 of the "Reply:"

(2) *Impact Testing*

Impact tests as provided in Par. U-142 shall be required for material meeting any of the following conditions:

(*a*) For service below —325 F; (*b*) for service below —20 F when; (1) carbon content exceeds 0.10 per cent; (2) nickel or chromium content exceeds the maximum of the AISI standard analysis range for the type of material specified; (3) material of a type containing titanium or columbium is given heat-treatment (3)(*c*) at temperatures under 1550 F; (4) material of a type not containing titanium or columbium is given heat-treatment (3)(*c*); (5) material is in the form of castings, or when; (6) material is weld metal; (*c*) for service at any temperatures when: (1) Grade Mc is not within the analysis range recommended in paragraph (1)(*b*) and is given heat-treatment (3)(*b*), or when; (2) Grade M or Type 309 is given heat-treatment (3)(*c*) at temperatures under 1650 F.

In paragraph (3) (*a*) of the "Reply" delete from the second sentence the words "but in no case less than one-half hour."

In paragraph (4) of the "Reply," "$^{1}/_{32}$ in." should be changed to "$^{1}/_{16}$ in." as an editorial correction.

In paragraph A(2)(*b*) of the Appendix, the fourth sentence should be revised as follows:

"The loss of impact strength (notch toughness) is usually appreciable in all grades but has been found to be severe in M and Mc grades after prolonged exposure to relatively high temperatures."

CASE No. 1110

Interpretation of Par. 112(c)

Inquiry: May austenitic stainless-steel pipe conforming to one of the grades of specification SA-158 be used for piping under the jurisdiction of Section I of the Code without a stress-relief heat-treatment after welding, as required by Par. P-112(*c*)?

Reply: It is the opinion of the Committee that the joints of all parts of austenitic stainless-steel welded under the provisions of Par. P-112 shall be heat-treated as required hereafter, except that those in pipe whose nominal thickness does not exceed $^{3}/_{8}$ in. need not be heat-treated, unless the customer and the manufacturer mutually agree that heat-treatment of the part is desirable.

(*a*) Heat-treatment shall be in accordance with Par. P-108 except that the joint shall be heated to at least 1300 F and the cooling rate may be as rapid as desired. The proper heat-treatment procedure depends largely on the intended service and shall be mutually agreed upon by the manufacturer and the purchaser.

CAUTIONARY NOTE: When heat-treatment is required because of thickness it is recommended that a columbium or titanium stabilized grade (type 347 or type 321) be used. Types 304 or 316 are susceptible to carbide precipitation if stress relieved at temperatures less than about 1700 F.

Proposed Revisions and Addenda to Boiler Construction Code

IT IS the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revisions of the rules and its Codes. Any suggestions for revisions or modifications that are approved by the Committee will be recommended for addenda to the Code, to be included later in the proper place.

The following proposed revisions have been approved for publication as proposed addenda to the Code. They are published herewith with corresponding paragraph numbers to identify their location in the various sections of the Code and are submitted for criticism and approval from anyone interested therein.

It is to be noted that a proposed revision of the Code should not be considered final until formally adopted by the Council of the Society and issued as pink-colored addenda sheets. Added words are printed in SMALL CAPITALS; words to be deleted are enclosed in brackets [ ]. Communications should be addressed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York 18, N. Y., in order that they may be presented to the Committee for consideration.

PAR. P-215

Paragraph P-215 is to be dropped from the Power Boiler Code.

TABLE U-3 Editorial Correction

Specification SB-126 has been superceded by Specification SB-178 and the present SB-178 should refer to alloy A-2 and the reference to Specification SB-126 should be changed to SB-178, alloy M-1

PAR. U-2(e) Revise as follows:

The dial of a pressure gage shall be graduated to approximately double the OPERATING pressure, [at which the relieving device is set to function] but in no case less than 1.2 times the pressure AT WHICH THE RELIEVING DEVICE IS SET TO FUNCTION.

PAR. U-64(e) Revise as follows:

Gas storage of vessels of riveted construction which are so constructed or installed as not to be capable of safely withstanding the weight of the large mass of water required to fill them for hydrostatic test, AND VESSELS FOR USE IN SERVICES WHICH WILL NOT TOLERATE THE PRESENCE OF TRACES OF A TESTING LIQUID AND WHICH CANNOT BE READILY DRIED, MAY BE TESTED PNEUMATICALLY TO A PRESSURE of at least, but which need not exceed, the maximum allowable working pressure of the vessel, provided the allowable working pressure does not exceed 80 per cent of that which would be permitted if the vessel were subjected to the regular hydrostatic test pressure.

PAR. U-64(f) Add the following wording as a second sentence and include the present as a third sentence, also substituting therein PRELIMINARY for the word [soap]:

FOR SHOP TESTED VESSELS, ANY OTHER PRELIMINARY LEAKAGE DETECTING PRESSURE TEST MAY BE USED IN LIEU OF THE 2 PSI SOAP TEST. THE PRELIMINARY TEST AT 2 PSI NEED NOT BE APPLIED TO SHOP TESTED VESSELS FOR USE IN SERVICES WHICH WILL NOT TOLERATE THE PRESENCE OF TRACES OF A TESTING LIQUID AND WHICH CANNOT BE READILY DRIED.

PAR. U-77(b) Add to the first sentence, eighth line the following wording in place of [if such a test is feasible]

. . . . . EXCEPT THAT THE HAMMER TEST NEED NOT APPLY TO A WALL THICKNESS OF $^{3}/_{16}$ INCH OR LESS.

PAR. U-77(e) Add to present subparagraph.

VESSELS FOR USE IN SERVICES WHICH CANNOT TOLERATE THE PRESENCE OF TRACES OF A TESTING LIQUID AND WHICH CANNOT BE READILY DRIED AND THE PARTS OF WHICH HAVE BEEN PREVIOUSLY TESTED BY HYDROSTATIC PRESSURE TO NOT LESS THAN $1^{1}/_{2}$ TIMES THE MAXIMUM ALLOWABLE WORKING PRESSURE OF THE VESSEL, SHALL BE GIVEN A PNEUMATIC TEST AS PRESCRIBED IN PAR. U-64(f).

THE ENGINEERING PROFESSION

News and Notes

As Compiled and Edited by A. F. Bochenek

Engineers Joint Council Discusses National and International Affairs

ENGINEERS Joint Council met in the Engineering Societies Building, New York, N. Y., on Jan. 20, 1950. R. E. Dougherty presided until officers for 1950 (see p. 264 of this issue) were elected and then relinquished the chair to the newly elected vice-president, James M. Todd, who presided in the absence of L. E. Young, newly elected president. When Dr. Young arrived he asked Mr. Todd to continue as presiding officer throughout the remainder of the meeting. The following matters under discussion are of general interest:

Annual Report

An annual report of the secretary, the first such report to be submitted to EJC, was presented by W. N. Carey, secretary of EJC during 1949. On page 263 of this issue the introductory paragraphs of the report are presented. The remaining portions of the report summarize the activities of EJC committees and panels during 1949.

International Relations

Dean S. S. Steinberg, who was chairman of the EJC delegation at the 1949 Brazil Conference (First Pan-American Engineering Congress, Rio de Janeiro, July 15–24, 1949), reported a recent meeting of the delegates. He spoke of the sincere desire of engineers in Latin America to form a Union of Pan-American Engineering Societies (UPADI), the constitution of which, patterned on the constitution of the Union of South American Engineers (USAI), said to be in successful operation, had been considered by EJC at its meeting of November 18, 1949. Although EJC had expressed profound interest in the formation of a union of engineers in the Western Hemisphere, it had not adopted the proposed UPADI constitution, but had suggested an alternative form of organization along the lines of the London Conference. Dean Steinberg expressed the fear that EJC's action might be interpreted in Latin America as lack of enthusiasm for and interest in the UPADI project. He pointed out that UPADI was directed to means by which engineers in the American continents could come to know one another better through personal and widespread participation in the work and conferences of the Union. The London Conference was on the "management" level, and, while suited to the conditions prevailing in the engineering societies of Western Europe, was not the kind of an organization desired by the engineers of Latin America.

It was emphasized in discussion that the action of EJC should not be interpreted as lack of enthusiasm for and interest in a union of engineers in the Americas. On the contrary, the idea had the wholehearted support of EJC. In the light of Dean Steinberg's comments and the discussion that followed, EJC requested its Committee on International Relations to give further consideration to the question of joining UPADI. It was suggested that the Committee enlarge its commission on Latin America to include more industrialists and particularly men of the highest ability and reputation, possessing a broad knowledge of Latin America and experience in Latin-American affairs.

[Following a meeting of the EJC Committee on International Relations, held on February 3, 1950, Malcolm Pirnie, chairman of the Committee, announced that the proposals made at the Rio de Janeiro conference had been unanimously approved by the Committee, and that "the Committee favors fullest co-operation with other engineering societies of the Americas to bring into being the proposed organization of engineering societies in this hemisphere. This action, he added, assures the fullest participation of United States engineering societies with those of other American nations, in an organizational meeting to be held in Havana at a date to be announced later to launch such a federation."]

Science Legislation

A letter addressed to about 50 deans in the universities, calling attention to the importance of a speedy enactment of a National Science Foundation Bill and signed by B. A. Bakhmeteff, chairman, EJC Science Legislation Panel, was read. The letter reviewed briefly the history of EJC's interest in unpartisan legislation discussed in the 80th Congress on a National Science Foundation. This legislation had been endorsed by the EJC Panel and other engineering organizations and was, in their opinion, the best piece of legislation so far written. Although the Bill known as S247 was unanimously passed last spring by the U. S. Senate and, after hearings instituted in the House of Representatives, the Committee for Foreign and Domestic Commerce favorably reported Bill H.R. 4846 to the House as a whole, enactment did not materialize because of a crowded calendar. The letter expressed the belief that the bill would be placed on the calendar of the House in the current session and urged the deans to take an interest in its progress.

National Water Policy

W. W. Horner presented a report of the EJC Panel on a National Water Policy, dated Dec. 28, 1949 (see Mechanical Engineering, February, 1950, p. 177), and a supplemental report dated Jan. 19, 1950, which took note of the Temporary Water Resources Policy Commission created by President Truman on Jan. 3, 1950 (see Mechanical Engineering, February 1950, p. 178). The Council received the reports, approved suggestions contained in the supplemental report, and authorized an expenditure of funds to insure prompt submission to the Temporary Commission of its views on a sound water-resources policy for the nation.

A report of the first meetings of the Commission, Jan. 14 and 15, 1950, appears on page 264 of this issue. Headquarters for the Commission has been established in Room 217, Executive Office Building, Washington, D. C.

Society Sections Outside U. S. A.

The Council considered a suggestion of the ASME Board on Public Affairs that EJC study the question of sections and student branches that engineering societies may wish to establish outside the United States, with a view to developing a more uniform policy between the Societies having membership in EJC. This matter was referred to the Committee on International Relations for study and report.

First EJC Annual Report Reviews Early History

FOR the first time since its organization Engineers Joint Council has compiled a comprehensive annual report. It was compiled in the office of the 1949 secretary for EJC, reviewed by the EJC's Committee of Secretaries, and received for the record by Engineers Joint Council at its meeting of January 20, 1950. An extract from the beginning of the report follows.

Engineers Joint Council is an evolution from the one-time Joint Conference Committee. The latter, established in October, 1941, to promote co-operation among the four Founder Societies, was composed of the presidents and the secretaries of the Societies. In 1942 the American Institute of Chemical Engineers became the fifth participating organization. As the scope of activity expanded, stimulated

by the urgent need for a united front of the profession during the years of World War II, the "Conference" concluded that its function was of greater significance than the name implied and, in September, 1945, Engineers Joint Council came into being. Thus, although EJC had its beginning in 1941, it has just rounded out its fourth full year under its present identity. They have been years of increasingly vigorous and constructive activity. At the year's end the total membership of the five Societies of EJC was 111,000.

New Constitution Approved

A major internal step in the development of EJC during the past year has been the ratification by governing bodies of Constituent Societies of a formal constitution to replace the previous rather informal by-laws. (See page 96, January, 1949, issue of MECHANICAL ENGINEERING). Under its terms, EJC now is composed of the two most available recent past-presidents and the secretary of each of the five principal national engineering Societies. Previously, the current president of the Societies had served with one past-president, with the result that these presidents carried an unduly heavy load during their first year on EJC. The new arrangement is a definite improvement.

In former years, meetings were held at irregular intervals, depending upon the amount and importance of work confronting Council. Because of the volume of matters requiring attention, and better to systematize procedure, it became increasingly evident that a regular schedule for meetings should be established. Consequently, the third Fridays of odd months now are official dates for EJC meetings. Meetings customarily are held in the Engineering Societies Building in New York, N. Y.

The Constitution (Article I, Section 2) states that the objectives of the EJC shall be:

(a) To advance the general welfare of mankind through the available resources and creative ability of the engineering profession; (b) to promote co-operation among the various branches of the engineering profession; and (c) to develop sound public policies respecting national and international affairs, wherein the engineering profession can be helpful through the services of the members of the engineering profession.

Upon that foundation, Engineers Joint Council in its role as the co-operative federating agency for the national societies representing the five basic branches of the profession, has been active in a wide variety of matters of national and international scope. Criteria for determining participation in any such matter are: (1) That it shall be of wide interest to the profession; and (2) that it shall be a matter having a direct impact on the profession or one regarding which it is believed that action by the profession can contribute to the public interest.

Unification of Profession

For years, EJC has been devoting study to stimulation of greater solidarity of the engineering profession. One of the most significant steps taken during 1949 was the calling of a conference, under the general auspices of EJC Committee on Unity of the Engineering Profession, for the purpose of developing specific recommendations as to measures for achieving further unity. Sixteen of the principal national engineering Societies were invited to participate. At the meeting on October 20, 1949, fourteen Societies were represented, delegates of the other two being unavoidably absent. As the result of general discussion, a committee was appointed to study the relative advantages of several suggested courses of action and to report back to the conference at a meeting to be held early in 1950.

The small expense incurred in connection with the work of EJC is significant. Each year a budget is established and the necessary funds are prorated among the constituent Societies in proportion to dues collections by each for the preceding fiscal year. While expenditures may vary within rather wide limits, depending on the character of projects undertaken, it is interesting to note that for 1948 and 1949, the total each year was $3900.

A copy of the EJC annual report for 1949 may be obtained by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Water-Resources Policy Commission Holds Its First Meeting

THE President's temporary Water Resources Policy Commission (see MECHANICAL ENGINEERING, February, 1950, p. 178) held its first meetings on Jan. 14 and 15, 1950, in the Executive Office Building, Washington, D. C.

All members of the Commission were present, including Paul S. Burgess, dean, College of Agriculture, University of Arizona, Lewis W. Jones, president, University of Arkansas, Samuel B. Morris of the Los Angeles Department of Water and Power, Leland Olds, New York, N. Y., R. R. Renne, president, Montana State College, Gilbert F. White, president, Haverford College, and Morris L. Cooke, Fellow ASME, chairman.

Upon its organization the Commission conferred with Frank Pace, Jr., director of the budget, and Elmer Staats, executive assistant director of the budget, who emphasized the great importance which the administration attaches to the working out of a comprehensive water-resources policy along lines which will enable such resources to make their maximum contribution to the long-range development of the country's economic life.

The director of the budget stated that the need for a thorough reconsideration of water-resources policy is widely recognized in the interested Government departments as well as in Congress.

At the conclusion of the meetings, Chairman Cooke stated:

"The Commission has decided on procedures which will assure rapid progress toward the objectives for which it was created. This will involve making the fullest possible use of the large volume of work which has been done in this field in the past, including the experience of the important agencies—federal, state and local, including private, which have been responsible for the previous consideration of water-resources problems.

"The Commission believes that the President's decision to initiate this reappraisal of water-resources policy is well timed in terms of the widespread public interest in a constructive solution of problems which have arisen in many sections of the country.

"We have before us communications from many individuals and organizations indicating a desire that all aspects of water resources used receive the full consideration which they deserve. The Commission feels that such interest on the part of the public would be of great help to it in its efforts.

"The Commission decided to include in its procedure an opportunity for all persons and organizations concerned with water resources, including governmental agencies—federal, state, and local—agricultural, labor and business organizations, technical societies, and associations seeking to safeguard particular phases of water-resources development, to bring to its attention their conception of the elements of a sound water-resources policy for the nation.

"The Commission recognizes that a sound water-resources policy must undertake to make the best possible provision not only for irrigation and drainage, flood control, navigation, and hydroelectric power, but also for the requirements of pollution abatement, silt and salinity control, domestic and industrial water supply, recreation and improvement in conditions for fish and wild life. The Commission considers that the objective of a sound national water-resources policy is to promote the full use of the water resources of the country for all useful purposes so combined as to yield for the people maximum benefits at minimum costs.

"The Commission will consider all aspects of water conservation from the headwaters of the country's rivers to the sea, including ground waters. The close relationship between proper handling of water and of soil must be constantly present in any consideration of water-resources policy.

"The object of the Commission will be to meet the desire of the President for a consistent and comprehensive policy in regard to the country's whole water-resources program through a careful review and reappraisal of the policies which have developed through the years of executive and legislative action."

* * *

Engineers Joint Council Elects Officers

AT the meeting of the Engineers Joint Council, held at the Engineering Societies Building, New York, N. Y., Jan. 20, 1950, Dr. L. E. Young, president, American Institute of Mining and Metallurgical Engineers, was elected president of EJC. James M. Todd, past-president ASME, was elected vice-president; E. H. Robie, secretary AIME, was elected secretary of EJC; and E. L. Chandler,

assistant secretary, American Society of Civil Engineers, was re-elected treasurer.

ASME members of EJC are: E. G. Bailey and James M. Todd, past-presidents; C. E. Davies, secretary; and R. M. Gates, past-president, alternate. James D. Cunningham, president ASME, is a member of EJC ex officio.

Theodore Limperg Receives Wallace Clark Award for 1950

THE SECOND presentation of the Wallace Clark International Award "for distinguished contributions to scientific management in the international field" was made in absentia to Prof. Theodore Limpberg of The Netherlands, at the annual dinner of the National Management Council, held at the Statler Hotel, New York, N. Y., Jan. 10, 1950. Professor Limperg, who retired recently as professor of industrial organization in the department of economic science at the University of Amsterdam, The Netherlands, was honored as a "scholar, teacher, patriot, and leader in national and international work in the field of scientific management."

The Wallace Clark International Award was established last year by The American Society of Mechanical Engineers, American Management Association, Society for the Advancement of Management, and the Association of Consulting Management Engineers, as an annual award to be presented through the National Management Council of the United States. The Award perpetuates the memory of the late Wallace Clark, Fellow ASME, who introduced the American concept of management to Europe following World War I. The award consists of a gold medal, a citation, and an autographed copy of the book, "The Challenge of American Know-How," by Pearl Franklin Clark.

H. B. Maynard, Mem. ASME, president, National Management Council, made the presentation, Cnoop Koopmans, The Netherlands general consul to the United States, accepted the award for Professor Limperg. Mr. Koopmans spoke briefly to express thanks for the honor bestowed upon his countryman and to note the important work of the NMC, whose contribution to the International Committee for Scientific Management (CIOS), he said, was helping to promote international understanding.

Lillian M. Gilbreth, Fellow ASME, described the background of the award and the biography of the recipient.

Other speakers on the program were Harold V. Coes, Fellow ASME, and until recently deputy and acting director, Industrial Division, Office of Special Representatives in Europe of the Economic Co-Operation Administration, and Lyman G. White, secretary, Committee on Nongovernmental Organizations, Economic and Social Council of the United Nations.

Mr. Coes, in an off-the-record talk, commented on some of the little-known aspects of the European industrial situation. Mr. White spoke on "The Emerging Age of World Co-Operation—a Challenge to Management."

ASME Boiler Code Committee Meets in Atlanta, Ga.

AT THE invitation of the Atlanta Section of The American Society of Mechanical Engineers, the ASME Boiler Code Committee held its regular January meeting at the Atlanta-Biltmore Hotel, Atlanta, Ga., Jan. 26, 1950.

Upon arrival in Atlanta, members of the Committee were tendered a reception and dinner at the Atlanta Athletic Club attended by Arthur Roberts, Jr., ASME Regional vice-president, and 120 members of the Atlanta Section, Southern industrial and educational representatives, and Southern state, insurance, and municipal officials interested in the work of the Committee. Bruce Sherrill, chairman of the ASME Atlanta Section, presided at the after-dinner program. E. W. O'Brien, past-president of ASME, in a brief message of welcome, cited the ASME Boiler Code Committee as one of the major safety and standardization activities of the Society. American experience and know-how in the boiler field, Mr. O'Brien said, is being made available to other countries of the world through the Society's acceptance in 1949 of the secretariat of an international boiler-code project.

Keen Interest in Committee Work

Following the introductory remarks, members of the Committee offered to answer questions about ASME Boiler Code activities. An extended question-and-answer period followed which reflected keen interest on the part of Southern engineers in the organization of the Committee and its procedures for arriving at interpretations of and revisions to the Code.

The same interest was evident the following day when a substantial number of Atlanta engineers, inspectors in Georgia and neighboring states, and members of the Atlanta Section observed the Committee as it conducted the business of its January agenda.

En route to and from the meeting, four members of the Committee stopped over at engineering schools to talk to ASME student Branches about the work of the Committee. A. C. Weigel spoke at Virginia Polytechnic Institute; Martin Frisch was speaker at the Georgia School of Technology student-branch meeting; H. C. Boardman visited the University of Alabama; and D. L. Royer spoke at Alabama Polytechnic Institute.

Similar Meetings Held in Other Regions

The practice of holding one regular meeting of the Boiler Code Committee away from New York, N. Y., was instituted several years ago to provide the opportunity for engineers in various ASME Regions to observe the Committee at work. Such meetings have already been held in Los Angeles, Chicago, and Boston. The choice of Atlanta for 1950 was influenced by the invitation of the Atlanta Section and the interest among Georgia engineers for the adoption of the ASME Boiler Code by the state and municipalities.

The ASME Boiler Code has been adopted by 38 states, many municipalities, Hawaii, Puerto Rico, Panama Canal Zone, and by all the provinces of Canada. The high regard in which the Code is held by American industry was one of the reasons why the International Organization for Standardization was eager for the ASME to assume the secretariat of the international boiler-code project.

25th Anniversary Marked by Guggenheim School of Aeronautics

THE twenty-fifth anniversary of the Guggenheim School of Aeronautics was observed at the College of Engineering, New York University, New York, N. Y., Jan. 26, 1950.

Honorary degrees of doctor of engineering were awarded to the following four men closely connected with the School and the development of aeronautical science: Harry F. Guggenheim, instrumental in establishing the School; Alexander Klemin, Mem. ASME, director of the School for its first fifteen years; Hugh L. Dryden, Fellow ASME, director, Na-

THE ASME BOILER CODE COMMITTEE HOLDS A REGULAR MEETING IN ATLANTA, GA., JAN. 26, 1950

[*Left to right:* H. B. Oatley, P. R. Cassidy, R. E. Cecil, Walter Samans, W. P. Gerhart, A. J. Ely (back to camera).]

Meetings of Other Societies

April 4–7

National Association of Corrosion Engineers, annual conference, Hotel Jefferson, St. Louis, Mo.

April 10–12

American Society of Lubrication Engineers, annual meeting, Hotel Statler, Detroit, Mich.

April 10–14

American Society of Tool Engineers, tool engineers industrial exposition, Convention Hall, Philadelphia Pa.

April 17–19

Society of Automotive Engineers, Inc., aeronautic meeting and aircraft-engineering display, Hotel Statler, New York, N. Y.

April 20–21

The Society for the Advancement of Management, time study and methods conference, Hotel Statler, New York, N. Y.

(For ASME Calendar of Coming Events see page 273)

tional Advisory Committee for Aeronautics; and Robert Moses, developer of the New York City airport and airport-access programs at LaGuardia and Idlewild Airports.

Reviewing the quarter-century history of the School, Professor F. K. Teichman, Mem. ASME, present director of the school, said that in 1921 the growing importance of aviation led to an investigation of its educational aspects by the College of Engineering and to a course of lectures by Professor Klemin to senior students during the academic year 1921–1922.

Professor Klemin guided the Guggenheim School of Aeronautics from the time of its founding until his retirement some 15 years later. He designed the original double-return wind tunnel, which was then the largest nongovernmental wind tunnel in the United States; he developed a moving belt to simulate ground effects for stationary models in the wind tunnel since it was not feasible to move the model; a mirror-Pitot designed to measure air speed in flight more accurately; an experimental rig for measuring spinning characteristics of airplanes in a horizontal tunnel; and a testing apparatus for autogyro modeled to eliminate scale effects. He was also instrumental in developing a power-plant laboratory, a towing basin, and other aeronautical developments of the school.

Engineering Literature

THE following publications were released by The American Society of Mechanical Engineers last month:

RECIPIENTS OF HONORARY DOCTOR OF ENGINEERING DEGREES AT THE SILVER-ANNIVERSARY CEREMONIES OF THE GUGGENHEIM SCHOOL OF AERONAUTICS, NEW YORK, N. Y., JAN. 26, 1950

(*Left to right:* Alexander Klemin, Mem. ASME; Harry F. Guggenheim; Hugh L. Dryden Fellow ASME; and Robert Moses.)

Welding Procedure

A new edition of Section IX Standard Qualifications for Welding Procedure and Welding Operator of the ASME Joint Construction Code. It contains 45 pages and incorporates all addenda to the Code issued since the last revision in 1946. Price is 90 cents.

Manlifts

A new American Standard Safety Code for Manlifts. This Code was formulated by the Association of Casualty and Surety Companies and the ASME under the procedures of the American Standards Association. The Code covers construction, maintenance, inspection, and operation of manlifts in relation to accident hazards to employees, and is intended as a guide for manufacturers and consulting engineers. The 22-page document is priced at 55 cents.

Gas Turbines

A Bibliography on Gas Turbines—1896–1948, compiled by the ASME Gas Turbine Power Division. This 141-page book was issued as a preliminary draft pending revisions which are expected to take 18 months. References are arranged in chronological order according to date of original publication. Additional references are in preparation. When a check has been completed on additional references, the bibliography will be published in final form. Draft copies may be obtained at $1 each.

Screwed Fittings

American Standard on Cast-Iron Screwed Fittings, 125 and 250 lb, ASA B16.4-1949. This Standard covers pressure ratings, sizes and method of designating openings of reduced fittings, markings, minimum requirements for materials, dimensions and tolerances, and threading for cast-iron screwed fittings for fixtures of 125 and 250 psi steam pressure. This standard is a major revision of the 1941 edition and represents the best current practice. Price is 60 cents.

ASME publications may be obtained from ASME Publication Sales Department, 29 West 39th Street, New York 18, N. Y.

People

IRVING LANGMUIR who received the Holley Medal of The American Society of Mechanical Engineers in 1943, retired in January, 1950, as associate director of Research Laboratory, General Electric Company.

JAMES J. KINDELBERGER, chairman of the board, North American Aviation, Inc., Downey, Calif., has been elected president of the Institute of the Aeronautical Sciences for 1950.

TITUS G. LECLAIR, assistant chief electrical engineer, Commonwealth Edison Company, Chicago, was nominated to succeed James F. Fairman as president of the American Institute of Electrical Engineers. Mr. LeClair was one of the leaders in the AIEE 1946 study on unification of the engineering profession.

LESTER T. AVERY, president, Avery Engineering Company, Cleveland, is the 1950 president of the American Society of Heating and Ventilating Engineers. He is a graduate of Case Institute of Technology.

The following awards were conferred recently by the Institute of Aeronautical Sciences for notable contributions to aeronautics: The Lawrence Sperry Award to ALEXANDER H. FLAX for contribution to methods of determining dynamic behavior of aircraft; Sylvanus Albert Reed Award to GEORGE S. SCHAIRER for contributing to the design and development of large swept-winged high-speed aircraft; John Jeffries Award to ARNOLD D. TUTTLE, medical director of the United Air Lines, for contributions to aeronautics through medical research, and Robert M. Losey Award to WILLIAM LEWIS, meteorologist for the United States Weather Bureau, for research work important to design of ice-prevention equipment.

LILLIAN M. GILBRETH, Fellow ASME, was awarded an honorary membership and the Julian C. Smith medal by The Engineering Institute of Canada "for Achievement in the development of Canada."

ASME NEWS

Excellent Program for 1950 ASME Spring Meeting

Headquarters: Statler Hotel, Washington, D. C.

AROUND of visits behind the scenes of some of the finest laboratories in the world, the eleventh Thurston Lecture, and an excellent technical and social program are some of the attractions of the 1950 Spring Meeting of The American Society of Mechanical Engineers to be held at the Statler Hotel, Washington, D. C., April 12–14, 1950.

Papers on fly-ash collection, marine gas-turbine research in Britain, management of research laboratories, gas-turbine engines for aircraft, quick starting of large turbines and boilers, and developing professional competence in industry are among the 45 interesting papers to be presented and discussed at 21 technical sessions.

A feature of the program will be a symposium on turbojet anti-icing. Admittance to this session will be restricted to those persons who have obtained advance clearance for it. Members interested in the subject are urged to write to James W. Wheeler, Mail Station 2Q38, Sperry Gyroscope Company, Great Neck, N. Y., for a security questionnaire. The questionnaire must be filled out and returned to Mr. Wheeler before March 30, 1950.

Inspection Trips

For members who are not acquainted with the scale of government-sponsored research, the meeting provides ample opportunity to get behind the scenes of some of the government research centers. On the program are inspection trips to the Naval Ordnance Laboratory, the David Taylor Model Basin, the Timber Engineering Company Laboratory, the Bureau of Standards, and the Naval Engineering Experiment Station. For the Power Division, there is the trip to the Potomac River Generating Station. A trip of general interest will be the one to the Naval Academy.

Junior Conference

A conference of junior members from Region III whose expenses to the Meeting will be paid by the Old Guard Committee will be held on Wednesday, April 12, at 8:00 p.m. The conference is being sponsored by the National Junior Committee as part of its program for 1950 aimed to acquaint junior members with the program of the Committee and to direct the thinking of recent graduates to a program of professional development, one in which both the ASME and the Engineers' Council for Professional Development have a stake.

William F. Ryan, Fellow ASME, vice-chairman of the ECPD Committee on Engineering Ethics, engineering manager, Stone and Webster Engineering Corporation, Boston, Mass., has consented to address the conference on the question "How Is Your P. D.?" (professional development).

1950 Thurston Lecture

On Wednesday, the eleventh Thurston Lecture will be delivered by Theodor von Kármán, director of the Guggenheim Aeronautical Laboratory, California Institute of Technology, Pasadena, Calif., and Giuseppe Gabrielli, chief engineer, Fiat Aircraft Works, Torino, Italy. Their subject will be "Specific Power Required for Propulsion of Vehicles (What Price Speed?)" The Thurston Lecture honors the memory of Robert Henry Thurston, first president of the ASME, and gives an opportunity for a leader in pure and applied science to reveal some new development or new application of science that offers promise of engineering and industrial use.

Luncheon Speakers

Senator Ralph E. Flanders, past-president and honorary member ASME, one of the few engineers working at a national legislative job, will speak at the Wednesday luncheon on "A Mechanic in the Senate." William C. Foster, acting administrator, Economic Cooperation Administration, Washington, D. C., will address members at the Thursday luncheon on "The Marshall Plan—An Instrument for World Peace."

Women's Program

An interesting women's program has been arranged, a feature of which is a tea at Blair House, with Mrs. Harry S. Truman as hostess. Invitations to the tea are limited to 100. Requests for invitations must be sent to Mr. W. G. Allen, 8306 Custer Road, Bethesda 14, Md., not later than March 30. The program includes a tour to Mount Vernon, a luncheon at Collingwood Inn, and sight-seeing trips to the National Art Gallery, National Cathedral, and the Capitol and other cultural institutions and historic monuments.

The Tentative Program

WEDNESDAY, APRIL 12

8:00 a.m.

Registration

8:30 a.m.

Inspection Trip

Naval Ordnance Laboratory

9:00 a.m.

Cutting Fluids—Metal Cutting Data and Bibliography

Experience With Machinability Repeat-Ability, by Edward J. R. Hudec, instructor, Case Institute of Technology, Cleveland, Ohio. (50—S-2)

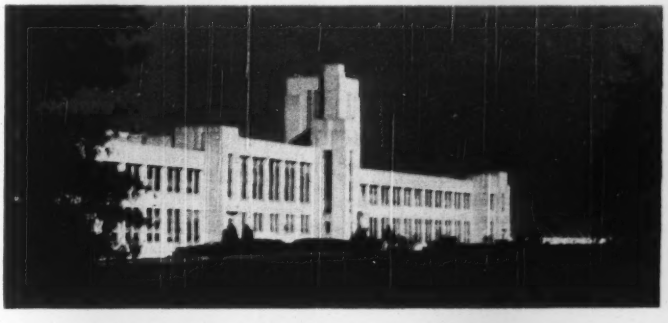
A Study of Heat Developed in Cylindrical Grinding, by R. S. Moore, Detroit manager, Quaker Chemical Products Company, Conshohocken, Pa., and R. E. McKee, assistant professor, and O. W. Boston, chairman, department of metal processing, University of Michigan, Ann Arbor, Mich. (50—S-11)

Machining of Heated Metals, by E. T. Armstrong, A. S. Cosler, Jr., and E. F. Katz, Battelle Memorial Institute, Columbus, Ohio. (50—S-5)

9:00 a.m.

Oil and Gas Power—Gas Turbine Power (I)

Pulsating Air Intake for Free-Piston Gasifier and Other Reciprocators, by E. C. Magde-



DAVID TAYLOR MODEL BASIN, ONE OF THE SCIENTIFIC INSTITUTIONS TO BE VISITED BY MEMBERS DURING THE ASME 1950 SPRING MEETING, WASHINGTON, D. C., APRIL 12–14

burger, Bureau of Ships, Navy Department, Washington, D. C.

Test Experience With the Annapolis 3500-Hp Experimental Gas-Turbine Plant, by A. C. Skortz, branch head, and F. R. Gessner, Jr., section head. Mechanical Laboratory, U. S. Naval Engineering Experiment Station, Annapolis, Md. (50—S-12)

9:00 a.m.

Fuels (I)

Fly-Ash Collection for Small Plants, by A. A. Peterson, chief engineer, Pratt-Daniel Corporation, East Port Chester, Conn.

Fly-Ash Collection Equipment for Small Boiler Installations, by W. L. Prout, chief engineer, The Green Fuel Economizer Company, Inc., Beacon, N. Y.

Factors Influencing Dust Collection for Small Boiler, by H. O. Danz, manager, dust-collector department, American Blower Corporation, Detroit, Mich.

9:00 a.m.

American Rocket Society (I)

Use of Strategic Materials in Jet and Rocket Applications, by Marvin C. Demler, colonel, U. S. Air Force, Arlington, Va.

Noon

Welcome Luncheon

Presiding: James D. Cunningham, president ASME

Speaker: Ralph E. Flanders, Senator from Vermont, past-president and honorary member ASME

Subject: "A Mechanic in the Senate"

1:45 p.m.

Inspection Trip

Potomac River Generating Station

2:30 p.m.

Gas Turbine Power (II)

Marine Gas-Turbine Research in Britain, by T. W. F. Brown, research director, The Parsons and Marine Engineering Turbine Research and Development Association, Pametrada Research Station, Walls-end, England. (50—S-3)

The Prospects of Gas Turbines in Naval Applications, by Comdr. W. T. Sawyer, U. S. N., Bureau of Ships, Navy Department, Washington, D. C., and Comdr. R. T. Simpson, U. S. N., Norfolk Naval Shipyard, Portsmouth, Va. (50—S-8)

2:30 p.m.

Industrial Instruments and Regulators

Measurement of Temperatures in High-Velocity Steam, by James W. Murdock, superintendent, instruments division, Naval Boiler and Turbine Laboratory, Philadelphia, Pa., and Ernest F. Fiock, chief, combustion section, National Bureau of Standards, Washington, D. C.

Relay Servomechanisms—The Shunt Motor Servo With Inertia Load, by T. A. Rogers, associate professor of engineering, and Walter C. Hurty, assistant professor, University of California, Los Angeles, Calif. (50—S-13)

2:30 p.m.

Management (I)

Research Management, by R. D. Bennett, technical director, Naval Ordnance Laboratory, White Oak, Md.

2:30 p.m.

Heat Transfer

Optimum Tube Size for Shell-and-Tube-Type Heat Exchangers, by F. D. Cardwell, research and specifications engineer, Chemical Construction Corporation, New York, N. Y. (50—S-6)

Loss Coefficients for Abrupt Changes in Flow Cross Section With Low Reynolds Number Flow in Single and Multiple-Tube Systems, by W. M. Kays, acting instructor of mechanical engineering, Stanford University, Stanford University, Calif. (to be presented by title). (50—S-7)

Local Coefficients of Heat Transfer for Straight Fins, by M. L. Ghai, project engineer, research and development department, Pullman-Standard Car Manufacturing Company, Hammond, Ind., and M. Jakob, research professor, Illinois Institute of Technology, Chicago, Ill.

Experimental Evaluation of Human Shape Factors With Respect to Floor Areas, by F. W. Hutchinson, professor of mechanical engineering, University of California, Berkeley, Calif. (to be presented by title). (50—S-4)

3:30 p.m.

Ladies' Tea

5:15 p.m.

Rice Lecture

Presiding: To be announced

Lecturer: Adriano Olivetti, Ivrea, Italy

Subject: To be announced

8:00 p.m.

Junior Committee

Conference on the subject: How Is Your P. D.?

Speaker: William F. Ryan, engineering manager, Stone and Webster Engineering Corporation, Boston, Mass., and vice-chairman of the Engineers' Council for Professional Development Committee on Engineering Ethics.

8:00 p.m.

Thurston Lecture

Presiding: Hugh L. Dryden, director, Aeronautical Research, National Advisory Committee for Aeronautics, Washington, D. C.

Lecturer: Theodor von Kármán, director, Guggenheim Aeronautical Laboratory, California Institute of Technology, Pasadena, Calif., and Giuseppe Gabrielli, chief engineer, Fiat Aircraft Works, Torino, Italy.

Subject: Specific Power Required for Propulsion of Vehicles (What Price Speed?)

THURSDAY, APRIL 13

9:00 a.m.

Inspection Trip

David Taylor Model Basin

9:00 a.m.

Gas Turbine Power (III)—Aviation (I)—American Rocket Society (II)

The Application of Gas-Turbine Engines to Naval Aircraft, by Carl C. Sorgen, Experimental Engines Branch, Bureau of Aeronautics, Washington, D. C.

Improving Turbojet Performance by the Use of a Variable-Area Exhaust Nozzle, by O. E. Rodgers, manager, development and research engineering, Aviation Gas Turbine Division, Westinghouse Electric Corporation, South Philadelphia Works, Lester, Pa.

9:00 a.m.

Machine Design (I)

Electric Induction Drives for Machinery and Vehicles, by Martin P. Winthers, vice-president, Eaton Manufacturing Company, Cleveland, Ohio.

Cable-Pulley Friction, by Wilhelm E. Schorr, instructor in mechanical engineering, New York University, New York, N. Y.

9:00 a.m.

Power (I)

Latest Technique for Quick Starts on Large Turbines and Boilers, by J. C. Falkner, manager, electric production department, D. W. Napier and C. W. Kellstedt, Consolidated Edison Company of New York, Inc., New York, N. Y. (50—S-1)

Sealing of High-Pressure Steam Safety Valves, by R. E. Adams, research engineer, Battelle Memorial Institute, Columbus, Ohio, and J. L. Corcoran, chief engineer, Consolidated Safety Valve Division, Manning, Maxwell and Moore, Inc., Bridgeport, Conn.

9:00 a.m.

Education

Training for Transition to Professional Responsibility, by William Oncken, Jr., director of training, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

Training for Career Development, by R. L. Randall, personnel officer, National Bureau of Standards, Washington, D. C.

Developing Professional Competence in Industry, by J. C. McKeon, manager, university relations, Westinghouse Electric Corporation, East Pittsburgh, Pa.

Noon

Luncheon

Presiding: F. M. Feiker, dean, George Washington University.

Speaker: William C. Foster, acting administrator, Economic Co-Operation Administration, Washington, D. C.

Subject: Marshall Plan—An Instrument for World Peace

1:45 p.m.

Inspection Trips

Bureau of Standards

Timber Engineering Company Laboratory

2:30 p.m.

Machine Design (II)

A Precision-Lens Testing and Copying Camera, by M. W. LaRue, head, mechanical and photo laboratory, Bell and Howell Company, Chicago, Ill.

Tests on the Dynamic Response of Cam Follower Systems, by D. B. Mitchell, mechanical research engineer, E. I. du Pont de Nemours and Company, Inc., Wilmington, Del.

2:30 p.m.

Aviation (II)

Symposium on Turbojet Anti-Icing

Note: Advance security clearance is required for each individual attending this symposium. Security questionnaire which can be obtained from James W. Wheeler, Mail Station, 2Q38, Sperry Gyroscope Company, Great Neck, N. Y., must be returned to him by March 20, 1950.

2:30 p.m.

Process Industries-Management

Plant Location in the Process Industries as Determined by Economic Conditions, by R. S. Aries, president, R. S. Aries and Associates, Brooklyn, N. Y., and D. F. Othmer, department of chemical engineering, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

2:30 p.m.

Fuels (II)—Power (II)

The Fluid-Energy Pulverizer and Its Application to Steam Generation, by L. D. Bechtel, consulting engineer, Carroll, Bechtel, and Langtry, Chicago, Ill., and G. M. Croft, manager, fuel-equipment department, Blaw Knox Company, Pittsburgh, Pa.

Practical Application of the Anthratube, by R. C. Johnson, vice-president, research, Anthracite Institute, Wilkes-Barre, Pa.

7:00 p.m.

Banquet

Toastmaster: W. L. Batt, president, SKF Industries, Inc., Philadelphia, Pa.
Speaker: To be announced
Subject: To be announced

FRIDAY, APRIL 14

9:00 a.m.

Safety—Washington Safety Society Chapter ASSE—Aviation (III)

Statistical Picture of Aircraft Accidents, by Jesse Lankford, chief, accident analysis division, Bureau of Safety Investigation, Civil Aeronautics Board, Washington, D. C.

More Air Traffic With Greater Safety, by S. P. Saint, director of air navigation, Traffic Control Division, Air Transport Association of America, Washington, D. C.

The Design and Development of Cross-Wind Undercarriages for Airplanes, by John Geisse, aviation consultant, Civil Aeronautics Administration, Washington, D. C.

9:00 a.m.

Power (III)—Applied Mechanics—Metals Engineering Effect of Temperature on Properties of Metals

Properties of Thin-Walled Curved Tubes of Short-Bend Radius, by T. E. Pardue, physicist, and I. Vigness, physicist, Naval Research Laboratory, Washington, D. C.

Investigation of Thermal Cracks in Large Turbine-Generator-Rotor Forgings, by A. W. Rankin, structural engineer, C. J. Boyle, C. D. Moriarty, and B. R. Seguin, General Electric Company, Schenectady, N. Y.

Thermal Shock and Other Comparison Tests of Austenitic and Ferritic Steels for Main Steam Piping, by W. C. Stewart, superintendent, Metallurgical Laboratory, U. S. Naval Engineering Experiment Station, Annapolis, Md.

9:00 a.m.

Lubrication

Oil Holes and Grooves in Plain Journal Bearings, by S. A. McKee, chief, Engines and Lubrication Section, and H. S. White, National Bureau of Standards, Washington, D. C. (50—S-9)

Film Thickness Between Gear Teeth—A Graphical Solution of Karlson's Problem, by M. D. Hersey, mechanical engineer, U. S. Naval Engineering Experiment Station, Annapolis, Md., and D. B. Löwdenslager, School of Mathematics, University of Virginia, Charlottesville, Va. (50—S-10)

9:00 a.m.

Wood Industries

Survey of Postwar Developments in Wood-Products Research, by Carl A. Rishell, director of research, Timber Engineering Company, and National Lumber Manufacturers Association, Washington, D. C.

How Increased Mechanical Efficiency Is Being Obtained in the Southern Pine Region, by Earl R. Schindler, manager, mechanical efficiency department, Southern Pine Association, New Orleans, La.

Machines and Forestry, by Anthony P. Dean, chief, Division of Engineering, U. S. Forest Service, Washington, D. C.

Report of Committee on Wood-Cutting Tools and Equipment, by Thomas D. Perry, consulting engineer, Moorestown, N. J., and F. Powell Forbes, manager, Weyerhaeuser Timber Company, Newark, N. J.

12:30 p.m.

Inspection Trips

U. S. Naval Academy

U. S. Naval Engineering Experimental Station

Process Industries Division and Pittsburgh Section Sponsor Conference

Pittsburgh, Pa., April 24–27

THE 1950 National Conference of the Process Industries Division of The American Society of Mechanical Engineers will be held in conjunction with the annual Mechanical Engineering Conference of the ASME Pittsburgh Section, at the Hotel William Penn, Pittsburgh, Pa., April 24–27, 1950. Cooperating in the joint conference will be the Mechanical Section of the Engineers Society of Western Pennsylvania, and the Pittsburgh Chapters of the Society for the Advancement of Management and the American Materials Handling Society.

PITTSBURGH, PA., WHERE THE ASME PROCESS INDUSTRIES DIVISION WILL HOLD ITS 1950 NATIONAL CONFERENCE IN CONJUNCTION WITH THE MECHANICAL-ENGINEERING CONFERENCE OF THE ASME PITTSBURGH SECTION, APRIL 24–27

Blast furnaces, spray drying, dust-collection and control problems, and design of chemical-process equipment will be among the subjects to be discussed at the technical sessions. In addition to luncheons and a banquet, the conference will feature visits to the Babcock & Wilcox Tube Company in Beaver Falls, Pa., and to the Robena Mine of the H. C. Frick Coke Company, Uniontown, Pa. An interesting program has been arranged for women.

The tentative program follows:

MONDAY, APRIL 24

9:00 a.m.

Registration

10:00 a.m.

Blast Furnaces

Variables in Blast-Furnace Operation, by Frank J. Kolano, student ASME, Carnegie Institute of Technology, Pittsburgh, Pa.

Dehumidification of Air for Blast Furnaces, by John Everett, Jr., office of Charles S. Leopold, Philadelphia, Pa.

10:00 a.m.

Spray Drying

Spray Drying, by S. J. McEntee, Jr., Western Precipitation Corporation, Los Angeles, Calif.

Noon

Luncheon

Speakers: A. M. G. Moody, chairman, ASME Pittsburgh Section; Philip Freneau, chairman, ASME Process Industries Division, T. R. Olive, chairman, ASME Professional Divisions Committee; A. C. Pasini, vice-president, ASME Region V.

2:00 p.m.

Dust Collection and Control

A Symposium:

The Engineer and Management Look at the Value of Dust Control, by T. J. Barry, consultant, Industrial Dust Control, Pittsburgh, Pa.

Bag-Type Dust-Collector Problems, by Herbert I. Miller, industrial-hygiene engineer, St. Joseph Lead Company of Pennsylvania, Josephtown, Pa.

Applications, Operation, and Maintenance of Cloth Filter-Type Dust Collectors, by W. O. Vedder, manager, dust-control department, Pangborn Corporation, Hagerstown, Md.

Unsolved Dust-Collection Problems in Process Industries and Difficulties Attending Their Solution, by P. F. Best, chief mechanical engineer, The Thermix Corporation, Greenwich, Conn.

Pilot-Plant Installation for Cleaning Ferromanganese Flue Gas, by C. A. Bishop, research associate, Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

What Can Be Done to Reduce Escaping Solids From Stacks Exhausting High-Temperature Gases From Furnaces, Kilns, Roasters, Driers, and Similar Process Equipment, by John M. Kane, chief engineer, dust-control division, American Air Filter Company, Inc., Louisville, Ky.

Various Applications of Electrostatic Precipitators as Applied to Process Industries, by N. W. Sultzer, Research Corporation, New York, N. Y.

2:00 p.m.

Driers

Roller Driers and Their Industrial Applications, by H. C. Jessen, project engineer, Johns-Manville Corporation, Manville, N. J.

Rotary Driers, by G. Gutzeit, director of research and testing laboratory, and J. Robert Spraul, assistant to director of research and testing laboratory, General American Transportation Company, East Chicago, Ind.

8:00 p.m.

Design of Chemical-Process Equipment

Techniques in High-Pressure Vessel Design, by E. L. Clark, chief of coal-hydrogenation section; A. M. Whitehouse, and H. J. Kandiner, Bureau of Mines, Bruceton, Pa.

Design and Construction of a Fischer-Tropsch Pilot Plant, by E. P. Lynch, process-engineering department; W. V. Munhall, and H. L. Barnebey, chemical-plants division, Blaw-Knox Construction Company, Pittsburgh, Pa.

8:00 p.m.

Waste Acid Treatment

The Development of Filtrate Neutralization in Lime Treatment of Waste Pickle Liquor, by Edgar F. Guillot, Filtration Engineers, Inc., Newark, N. J.; E. S. Tanski, and G. R. Osterfeld (deceased) Marblehead Lime Company, Chicago, Ill.

Recovery of Waste Iron Sulphate-Sulphuric Acid Solutions, by F. L. Bartholemew, assistant secretary and sales executive, Chemical Construction Company, New York, N. Y.

TUESDAY, APRIL 25

9:00 a.m.

Synthetic Fuels

The Use of Oxygen in the Production of Synthetic Fuels From Coal, by L. L. Hirst, chief, coal-to-oil demonstration branch, H. R. Batchelder, R. F. Tenney, R. G. Dressler, and L. C. Skinner, Bureau of Mines, Louisiana, Mo.

9:00 a.m.

Management

Recent Applications of Statistical Techniques to New Fields, by Delmar Dague, student SAM, industrial administration, Carnegie Institute of Technology, Pittsburgh, Pa.

Methods Time Measurements, by Haylett B. Shaw, vice-president, Methods Engineering Council, Pittsburgh, Pa.

2:00 p.m.

Materials Handling

Bulk-Handling Methods, by J. H. Klink, student ASME, mechanical engineering, University of Pittsburgh, Pittsburgh, Pa.

Development of Belt-Conveyor Transportation, by R. W. Rausch, chief engineer, Link Belt Company, Chicago, Ill.

The Proposed Belt-Conveyor System in Ohio, by Noel R. Michell, secretary, Riverlake Belt Conveyor Lines, Inc., Akron, Ohio

2:00 p.m.

Application of Oxygen Plants to Process Industries

Panel Discussion: Representatives of corporations with a primary interest in this field will discuss present trends in the application of oxygen plants to process industries.

7:00 p.m.

Banquet

Presentation of Honors and Awards by Pittsburgh Section and Process Industries Division, ASME.

Speaker: James D. Cunningham, president, ASME

Subject: The Engineer's Civic Responsibility

WEDNESDAY, APRIL 26

9:00 a.m.

Metalworking

Cold Extrusion, by W. J. Meinel, president, Heintz Manufacturing Company, Philadelphia, Pa.

Cemented-Carbide Compositions for High-Temperature Service, by J. C. Redmond, director of research, Kennametal, Inc., Latrobe, Pa.

9:00 a.m.

Radiant Heating

Mill-Production Experience With Fast Radiant Heating, by Frederick O. Hess, president, Selas Corporation of America, Philadelphia, Pa.

Panel Discussion: Various representatives of industry will discuss thoroughly the subject of radiant heating and its numerous applications.

11:30 a.m.

Inspection Trip to Babcock & Wilcox Tube Mill and Continuous Casting Operation, Beaver Falls, Pa.

THURSDAY, APRIL 27

8:30 a.m.

Inspection trip to Robena Coal Mine, Uniontown, Pa.

ASME Region VIII to Hold Meeting in Dallas, Texas

Baker Hotel, March 30–April 1

REGION VIII of The American Society of Mechanical Engineers, under the leadership of its vice-president, Carl J. Eckhardt, has taken the lead in sponsoring a new kind of ASME meeting, one oriented on a regional rather than a national basis.

The meeting will be held at the Baker Hotel, Dallas, Texas, March 30–April 1, 1950, and will provide the background for the Region VIII Administrative Committee Meetings and Southern Student Branch Conference. Actually, the meeting will be a convocation of Region VIII leadership and should stimulate interest in the work of the ASME in the states of Wyoming, Colorado, New Mexico, Oklahoma, Texas, Arkansas, and Louisiana, which compose Region VIII.

The program, which will take up such subjects as gas turbines, stamping and drawing of steel, outdoor power plants, welding, aircraft, textiles, and management, was planned with an ear tuned to the technological interests of engineers in the Southwest.

Spring is an appealing season in Texas. The attractive program, the ample hotel facilities, and the many outdoor events which the local committee have planned should attract a large attendance.

The following persons are in charge of arrangements: H. R. Pearson, general chairman; Glyn Beesley, vice-chairman; Clifford H. Shumaker, meetings and papers; W. B. Gregory, hotel; Leslie W. Cumber, registration; Arnold R. Mozisek, entertainment; C. A. Besio, inspection trips; F. C. Justice, publicity; Stanley Patterson, finance; J. W. Lacy, student activities; and Mrs. C. A. Cowles, ladies.

The program follows:

THURSDAY, MARCH 30

8:30 a.m.

Registration

10:00 a.m.

Opening Session

Address of Welcome: The Hon. Wallace Savage, Mayor, Dallas, Texas

Speakers: Dollars and Sense, by James M. Todd, past-president, ASME

The Engineer in Industrial Relations, by Guy B. Arthur, Jr., president, Management Evaluation Services Inc., Toccoa, Ga.

Luncheon

12:30

Presiding: Robert L. Rowan, Houston, Texas

Address: An Inventory of Worthy Professional Objectives in a Critical Period in the Nation's History, by Carl J. Eckhardt, vice-president, ASME Region VIII.

Session II

2:30 p.m.

Operating Results of Gas Turbines, by Otis Howard, manager of operation, Oklahoma Gas and Electric Company, Oklahoma City, Okla.

Cooling Performance of a Lake When Used for Industrial Purposes, by Robert F. Throne, superintendent of steam production, Public Service Company of Colorado, Denver, Colo.

Trends in Design and Operation of Outdoor Power Plants, by Louis Elliott, consulting engineer, Ebasco Services Inc., New York, N. Y.

Social Hour

Evening

Chuck wagon feed and get-together at the John W. Carpenter ranch

FRIDAY, MARCH 31

Session III

9:30 a.m.

Tidelands Seismographic Survey System, by L. C. Paslay, Marine Instrument Company, Dallas, Tex.

Simplified Well Calculations, by A. A. Hardy, chief engineer, W. C. Norris Manufacturer, Inc., Tulsa, Okla.

Gas Pipe Lines, by A. Russell Young, manager, Gas Division, J. F. Pritchard Company, Kansas City, Kan.

12:30 p.m.

Luncheon

Presiding: A. A. Hardy, chairman, ASME Mid-Continent Section

Address: C. E. Davies, secretary ASME

2:00 p.m.

Inspection Trips

Evening

Banquet

Address: James D. Cunningham, president ASME

SATURDAY, APRIL 1

Session IV

9:00 a.m.

Water Conservation, by Marvin C. Nichols, Freize and Nichols, Fort Worth, Texas

Wood Deterioration in Cooling Towers, by Donald R. Baker, Engineering Research Division, The Marley Company, Kansas City, Kan.

Lubrication Problems, by William Robertson, Humble Oil and Refining Company, Houston, Texas

Actions of the ASME Executive Committee

At a Meeting at Headquarters Jan. 19, 1950

A MEETING of the Executive Committee of the Council was held in the rooms of the Society, Jan. 19, 1950. There were present:

James D. Cunningham, chairman; F. S. Blackall, jr., Forrest Nagler, Albert C. Pasini, and Ralph A. Sherman of the Executive Committee; H. E. Whitaker (Finance Committee); Joseph L. Kopf, treasurer; E. J. Kates, assistant treasurer; E. G. Bailey and James M. Todd, past-presidents; A. R. Mumford, vice-president; C. E. Davies, secretary; and Ernest Hartford, executive assistant secretary.

Constitution and By-Laws

The Board on Membership was requested to prepare an amendment to Paragraph 12 Article B5 for submission to the Committee at a later date. This paragraph concerns the conferring of life membership on those who have paid dues for 35 years or who have reached the age of 70 after having paid dues for 30 years.

Research

A research agreement between the Society and The Research Foundation of The Ohio State University was extended to Dec. 14, 1950. The agreement covers project No. 335, whose objective is the determination of coefficients of discharge of eccentric and segmental orifices.

Old Guard Committee

The Committee expressed its appreciation to the members of the Old Guard Committee for their program of encouraging participation of young engineers in the affairs of the Society. The Old Guard Committee is paying traveling expenses of one junior member from each Section in Region III to attend the 1950 Spring Meeting; one junior from each Section in Region IV to attend the 1950 Semi-Annual Meeting, and one junior member from each Section in Region II to attend the 1950 Fall Meeting. In addition, the Old Guard Committee pays travel expenses of student prize winners, provides prizes for the student conferences, and pays the expenses of the junior members of the National Junior Committee.

Nuclear Energy Glossary

Publication by the Society of the Nuclear Energy Glossary was approved.

Small Plant Management

Publication of a book on small-plant management by the McGraw-Hill Publishing Company was approved. The book was prepared by the Management Division and recommended for publication by the Professional Divisions Committee.

Sections

A change of the name of the Raleigh Section to the Eastern North Carolina Section was approved. Authorization was granted for the establishment of the Sabine Subsection of the South Texas Section and the Albuquerque Subsection of the Rocky Mountain Section.

A communication from the temporary chairman of the ASME Mexico group, authorized during the 1949 Annual Meeting, was noted. The letter expressed the opinion that since the AIEE and the ASCE have organized Sections in Mexico, mechanical engineers would be at a disadvantage if they were not granted full section status. A policy statement on organizing sections of Founder Societies outside the U. S. A. is currently under consideration by the EJC.

ECPD Uniform Membership Grades

It was voted to refer the ECPD statement of minimum requirements for grades of membership, approved at its annual meeting in October, 1949, to the Board on Membership, to develop a presentation for discussion at the coming Regional Administrative Committee Meeting.

ASCE Centennial Celebration

At the request of the American Society of Civil Engineers, permission was granted to use the ASME emblem in a proposed design which the ASCE is preparing for its centennial celebration in 1952. The plan for the centennial calls for participating Societies of the Engineers Joint Council to join in the centennial celebration by holding simultaneous meetings. The Committee expressed itself as generally favorable to ASME participation in the ASCE centennial celebration planned for Chicago.

Meeting on Heat-Transfer

In connection with a general discussion on heat transfer to be held in London in 1951, it was voted that ASME assume responsibility jointly with The Institution of Mechanical Engineers for planning the gathering; also that the Society organize a committee on North American participation in the event by inviting co-operation of 11 scientific societies interested in heat transfer. A sum of money was also appropriated from the development fund to cover initial expenses, the money to be regained by sale of bound volumes of the proceedings.

Visit of Dr. H. J. Gough

On behalf of ASME, a formal appreciation to The Institution of Mechanical Engineers was voted for the results of Dr. H. J. Gough's visit and his participation in the ASME Annual Meeting.

ASME Junior Forum

Compiled and Edited by a Committee of Junior Members

National Junior Committee Plans Program for 1950

THE National Junior Committee of The American Society of Mechanical Engineers spent Jan. 20, 1950, engrossed in a discussion of what the Committee could do to encourage more participation on the part of the young engineer in the affairs of the Society.

The meeting, held at Society Headquarters, was the 19th since the Committee was organized in 1947. In addition to D. E. Jahncke, chairman, F. Everett Reed, George B. Thom, and B. H. Edelstein, members of the Committee, there were present H. D. Moll, Walter F. Coles, Jr., and Albert Schade, 3rd, of the Philadelphia Section; William P. Wier of the Rochester Section; Edwin P. Nye of the Central Pennsylvania Section; Glenn R. Fryling and H. J. Scagnelli of the Metropolitan Section; and A. F. Bochenek and Ernest Hartford, ASME staff.

New Directory

Copies of a new directory of active junior members in more than 50 Sections were distributed to those present. The names listed were supplied by Section officers who replied to a questionnaire last summer. The directory was prepared by the Committee to serve as an administrative tool.

It will be put into use immediately by the Committee's Regional corresponding members, men who have been assigned the task to correspond regularly with junior members listed in the directory. The purpose of the corresponding members is to stimulate an exchange of information between the Committee and interested junior members in each Section. The ideas and opinions which such correspondence can bring to light may be useful in sustaining interest in the Forum.

The Regional corresponding members of the Committee are: Region I, Sheldon E. Young, John G. Wilson; Region II, Joseph A. Falcon; Region III, Edwin P. Nye, William P. Wier, Jr.; Region IV, Joseph C. Thompson; Region V, Carl Meile, Victor S. Rykwalder; Region VI, John B. Burkhardt, Andrew J. Snider, 3rd; Region VII, Walter Coles, Jr.; Region VIII, Albert Schade, 3rd.

The availability of a directory of juniors exercising leadership in the Sections suggested the idea of using the names listed in it as a panel to consider questions proposed by the National Junior Committee in about the same way that an advertising agency in conducting market research on the shape of a maple syrup bottle would ask a carefully selected list of consumers what they thought of the bottle. The proposed panel could be asked to cooperate in answering questions about matters of interest to junior members in the field of professional development. It was also suggested that an incentive be provided for members of the panel, and that free preprint-coupon books would serve that purpose well.

Old Guard Project

The Committee noted with pleasure that the Old Guard Committee of the Society, which is custodian of funds contributed by members who no longer are required to pay dues, had decided to pay traveling expenses of one junior member of each Section in Region III to the Spring Meeting to be held in Washington, D. C., April 12 to 14, 1950. The plan was to be extended also to the juniors in Region IV for the 1950 Semi-Annual Meeting, and the juniors in Region II for the 1950 Fall Meeting. Each section will designate the junior who will benefit from the plan.

Spring Meeting

Encouraged by its success at the 1949 Annual Meeting, it was decided to plan ahead for similar sessions at the four national ASME meetings in 1950. It was the consensus that there was advantage in deciding on a general theme for the year and in planning each of the sessions around it. As the result of many suggestions stressing the importance to the young engineer of professional development, the Committee agreed to select as the theme for 1950, the challenge, "How Is your P. D.?" (P. D. meaning professional development).

With the Spring Meeting only one month away, the Committee was informed that it was too late to plan for a formal session, but that an informal meeting was still a possibility. It was decided, therefore, to hold an informal conference to which the 13 junior members from Region III, whose attendance was to be sponsored by the Old Guard Committee, would be invited. The conference would provide an opportunity to discuss the work of the National Junior Committee and junior-member problems of importance to Region III. As a main speaker, it was decided to invite some member who was active on the Engineers Council for Professional Development to describe ECPD projects aimed at helping young engineers in the period immediately following graduation.

Junior Advisers

The Committee's recommendations with respect to appointment of junior advisers on five additional standing committees was favorably received. Junior advisers will be added to three of the Committees, Membership Development, Engineers Registration, and Education Committees, but not to the Admissions and Membership Review Committees, the nature of whose work is such that junior advisers serving these committees would have little to contribute.

It's Up to Us

AS ONE looks around at a Section meeting and sees only a handful of junior members present, he is likely to be quite discouraged when he realizes that a rather large percentage of the Section membership is composed of juniors.

It is believed by some that one of the reasons for the lack of junior attendance at Section meetings is due to the cool reception a new young member receives when he does attend. Everybody seems to have a good time but him. Everybody knows everybody else; he knows no one. The older members are busy fostering old friendships or discussing business. Many of the younger members seemingly form cliquish barriers which appear to be impenetrable. We all know that the ASME is encouraging junior participation, and is pleading for increased attendance. But when the young fellow shows up, he is quietly set aside to enjoy the meeting as best he can. After a few such experiences, he decides that unless the topic of the meeting is particularly suited to him, the event is not worth the price of the meal.

This particular problem must be solved by ourselves. It's up to us. One method is to get together a small group of interested juniors. By discussion, it will become obvious that most of these men are concerned over the lack of support of section functions on their part, and also on the part of other juniors. At such gatherings it is often wise to invite at least one section officer, the chairman, if possible. You will find these gentlemen much concerned over our problem. Obviously the present-day juniors are the future ASME.

The first specific action can be to make a resolution for all those present to attend the next section meeting. That is not enough. It must also be resolved that each junior present contact at least one other junior member.

The above procedure will assure that each junior who does attend the section meeting as a result of this action, will know at least one other junior present. To further increase the sociability of the meeting for the younger members, it is probable that the members of the section executive committee will be very glad to make a point of introducing themselves to any younger members they do not know. To go further, a "junior corner" may be organized and so identified in order that any neophyte may feel free to step up and be appropriately welcomed.

Although the foregoing proposal is certainly not the complete answer to the problem, it is hoped that by concerted effort in this direction more interest in section activities can be inspired and subsequently more complete solutions discovered.

By John G. Wilson, Jun. ASME,
Littleton, Mass.

1950 Society Records Sent Upon Request

MEMBERS of The American Society of Mechanical Engineers who wish to receive copies of Personnel of Council, Boards, and Committees should address their requests to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

The Society Records list officers and the Council, personnel of boards and committees, professional divisions, sections, student branches, committees on research, standardization, safety, boiler code, and power test codes. There is a picture and short biography of James D. Cunningham, president, ASME. Awards and lectureships, with latest recipients and lecturers, are listed followed by honorary members, living present and former officers, deceased past-presidents, treasurers, and secretaries, and an index of the record completes the contents of material.

* * *

MECHANICAL ENGINEERING is pleased to announce that the back copies of ASME Transactions, Journal of the ASME, and MECHANICAL ENGINEERING which were made available to the readers of this magazine have been given to the University of Massachusetts, Amherst, Mass. Mrs. Walter Hagerty, of Pottstown, Pa., who so graciously offered the magazines, received many replies to the announcement published in the November, 1949, issue of MECHANICAL ENGINEERING.

ASME Sections

Coming Meetings

Arizona: March 18. Section meeting at Phoenix. Subject: Manufacturing. Speaker to be announced.

Baltimore: March. Inspection trip to the Continental Can Company. Sponsor, L. E. Carter.

March 27. Engineers Club of Baltimore, 6 West Fayette Street. Cocktails at 6 p.m., dinner at 6:30 p.m., and section meeting at 8 p.m. Subject: Management, by U. S. Senator Ralph E. Flanders of Vermont. Sponsor, L. E. Herbert.

Detroit: March 22. Rackham Memorial Building. Materials-Handling Meeting.

Erie: March 14. General Electric Community Center at 8 p.m. Discussion: Current Research on Steam Motive Power, by E. J. Boer.

Iowa-Illinois: March 28. Izaak Walton League Clubhouse at Ike's Peak. Dinner at 6:30 p.m., followed by a tour of the E. I. du Pont de Nemours and Co., Inc., cellophane plant, Clinton, Iowa. Sponsor: W. P. Sprague.

Kansas City: March 13. University Club at 8 p.m. Subject: Engineers in Civic Development, by Ellsworth Green.

Metropolitan Section: March 7. Process and Metals Division, Room 501[1] at 7:30 p.m. Subject: Properties of Metals at Elevated Temperatures, by G. V. Smith.

March 9. Engineers' Forum, Room 1101[1] at 7:30 p.m. Subject: Patents—Engineers—Inventors.

March 9. Woman's Auxiliary, Engineering Woman's Club, 2 Fifth Avenue at 12:30 p.m. Annual Benefit Luncheon (Bridge or Canasta).

March 15. Junior Committee, Room 502[1] at 7:30 p.m. Subject: Oil Burners and Their Application to Industrial Furnaces, by A. J. Turpin.

March 20 and 22. Regional Administrative Committee Meeting, Room 1101[1] at 7:15 p.m.

March 23. IIRD, Room 1101[1] at 7:30 p.m. Subject: Force-Balance Measuring Instruments, by U. A. Rothermel.

March 24. Joint meeting, ASME, ASTM, Room 501[1] at 8 p.m. Subject: Electronics Research for the Department of National Defense, by E. A. Speakman.

March 29. Engineers' Forum, Henry George School of Social Science, 50 East 69th Street, at 7:30 p.m. Subject: A Sound Investment Program for Engineers, by L. M. Greene.

Philadelphia: March 7. Professional Division meeting. Towne School, University of Pennsylvania at 8 p.m. Subject: Automatic Control of Neutralization of Industrial Wastes, by W. N. Greer.

March 17. Joint meeting with SNAME. Engineers' Club, 1317 Spruce Street, at 7:30 p.m. Subject: Modern Tanker Machinery. Speaker to be announced.

March 28. Junior meeting. Engineers' Club, 1317 Spruce Street at 8 p.m. Subject: Recent Application and Design of Spreader Stokers, by J. L. Bainbridge.

Plainfield: March 15. Elks Club, Elizabeth at 8:15 p.m. Subject: Magnesium. Speaker to be announced.

Southern California: March 1. Mechanical Engineering Building, California Institute of Technology, Pasadena at 7:30 p.m. Subject: Pipe-Line Surge Chambers, by E. E. Everett.

March 8. Mechanical Engineering Building, California Institute of Technology, Pasadena at 7:30 p.m. Subject: Flanges, Their Design and Manufacture. Speaker to be announced.

March 15. Mechanical Engineering Building, California Institute of Technology, Pasadena at 7:30 p.m. Subject: Writing of Engineering Specifications, 9th-Class Session, by A. Hunter.

March 22. Mechanical Engineering Building, California Institute of Technology, Pasadena at 7:30 p.m. Subject: High-Pressure Packings and Mechanical Seals, by R. G. Roshong.

March 28. Institute of the Aeronautical Sciences, 7660 Beverly Blvd., Los Angeles. Subject: Industrial Research and Its Applications for the West Coast, by A. M. Zarem. Subject: Centralized Applied Mechanics Research, a Service to Industry, by J. W. Edgemond, Jr.

Southern Tier: March 27. Section meeting preceded by a dinner at Binghamton, N. Y. Subject: Gas Turbines, by a representative from the General Electric Company, Schenectady, N. Y.

Youngstown: March 9. Great Hall, Trinity Methodist Church. Subject: The Story of Rubber, by J. D. Morrow.

[1] Engineering Societies Building, New York, N. Y.

ASME Calendar

of Coming Events

March 30–April 1
ASME, Region VIII, Annual Meeting, Baker Hotel, Dallas, Texas

April 12–14
ASME Spring Meeting, Hotel Statler, Washington, D. C.
(Final date for submitting papers was Dec. 1, 1949)

April 24–26
ASME Process Industries Division Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was Dec. 1, 1949)

June 12–16
ASME Oil and Gas Power Division Conference, Lord Baltimore Hotel, Baltimore, Md.
(Final date for submitting papers was Feb. 1, 1950)

June 19–23
ASME Semi-Annual Meeting, Hotel Statler, St. Louis, Mo.
(Final date for submitting papers was Feb. 1, 1950)

June 22–24
ASME Applied Mechanics Division Conference, Purdue University, Lafayette, Ind.
(Final date for submitting papers was Feb. 1, 1950

Sept. 18–22
ASME Instruments and Regulators Division Conference, Municipal Auditorium, Buffalo, N. Y.
(Final date for submitting papers—May 1, 1950)

Sept. 19–21
ASME Fall Meeting, Hotel Sheraton, Worcester, Mass.
(Final date for submitting papers—May 1, 1950)

Sept. 25–27
Petroleum Mechanical Engineering Conference, Hotel Roosevelt, New Orleans, La.
(Final date for submitting papers—May 1, 1950)

Oct. 23–25
ASME Fuels Division Conference, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers—July 1, 1950)

Nov. 26–Dec. 1
ASME Annual Meeting, Hotel Statler, New York, N. Y.
(Final date for submitting papers—Aug. 1, 1950)

(For Meetings of Other Societies see page 266)

Section Activities

REPORTS of the following ASME Section Meetings were received recently at headquarters.

Akron-Canton, Jan. 19. Speaker: H. E. Churchill. Subject: The Studebaker Automatic Transmission. Attendance: 140.

Atlanta, Jan. 25. Joint meeting with Boiler Code Committee. Open forum on purpose of code and organization. Attendance: 112.

Baltimore, Jan. 17. Speaker: J. D. Cunningham, president ASME. Subject: The Civic Responsibility of an Engineer. Attendance: 159.

Central Indiana, Jan. 20. Joint meeting with Rose Polytechnic Institute Branch. Speaker: P. McGrain. Subject: Flood Control in Indiana. Attendance: 75.

Central Pennsylvania, Jan. 17. Joint meeting with AIEE, IRE, and Pennsylvania State College student branch. Speakers: R. B. Power and J. M. Robertson. Subject: The Garfield and Thomas Water Tunnel. Attendance: 150.

Chattanooga, Jan. 13. Speaker: P. H. Merriman. Subject: Welding of Aircraft. Attendance: 45.

Chicago, Jan. 10. Speaker: J. D. Cunningham, president ASME. Subject: The Engineer's Civic Responsibility. Attendance: 220.

Columbus, Jan. 10. Speaker: Professor P. N. Lehoczky. Subject: Management Policies Attacked by Unions. Attendance: 50.

Dayton, Jan. 11. Joint meeting with ASM. Speaker: H. C. Cross. Subject: Titanium and Its Alloys. Attendance: 125.

East Tennessee (Oak Ridge), Jan. 26. Speaker: J. A. Good. Subject: Utiliscope—Television in Industry. Attendance: 50.

(Upper East Tennessee), Jan. 27. Speaker: E. W. Palmer. Subject: Where Do We Go From Here? Attendance: 150.

Hartford, Jan. 17. Speaker: R. Morrisson. Subject: Gas Turbines. Attendance: 90.

Iowa-Illinois, Jan 24. Speaker: F. W. Lovett. Subject: Conveying in Industry. Attendance: 42.

Metropolitan, Jan. 18. Speaker: J. Kopelson. Subject: Polaroid Land Camera.

Ontario, Jan. 12. Speaker: G. H. Rowat. Subject: Manufacture of Antifriction Bearings. Attendance: 100.

Philadelphia, Wilmington Subsection, Jan. 18. Speaker: Emil Ott. Subject: What Makes a Plastic a Plastic? Attendance: 76.

Piedmont-Carolina, Jan. 20. Speaker: J. J. Owen. Subject: Mechanical Engineering in Textile Research. Attendance: 65.

Pittsburgh, Westmoreland Subsection, Jan. 5. Speakers: C. T. Evans, Jr., and J. R. Redmond. Subject: Recent Developments in High-Temperature Material, Metals, and Ceramals. Attendance: 61.

Rocky Mountain, Jan. 16. Speaker: B. F. Soffe. Subject: Water—Its Importance to Industry and How to Treat It. Attendance: 43.

St. Louis, Jan. 27. Speaker: J. F. Sutherland. Subject: Jet Airplanes for Naval Use. Attendance: 70.

Schenectady, Jan. 19. Speaker: W. J. Eckert. Subject: The IBM Selective Sequence Electronic Calculator. Attendance: 70.

Southern Tier, Jan. 23. Speaker: Carl Beach. Subject: Machine Tools—Their Past, Present, and Future. Attendance: 45.

Washington, D. C., Jan. 12. Speaker: W. C. Schroeder. Subject: Recent Developments in Synthetic Liquid Fuels. Attendance: 45.

Youngstown, Jan. 12. Speaker: L. F. Grandmontagne. Subject: Astronomy. Attendance: 70.

Jan. 26. Speaker: A. J. Koti. Subject: Protective Coatings and Finishes. Attendance: 25.

Student Branch Activities

REPORTS of the following ASME student branch meetings were received recently at Headquarters:

University of Akron, Jan. 12. Speaker: E. N. Poole. Subject: Coal Pulverizers. Attendance: 23.

Alabama Polytechnic Institute, Jan. 9. Business meeting. Attendance: 76.

Jan. 24. Speaker: Arthur Roberts. Subject: Inspirational talk to students to put their best into their profession. Film: Motors for Aviation. Attendance: 60.

Brown University, Jan. 6. Speaker: Mr. Kinney. Subject: The File—Kinds, Uses, and Manufacture. Attendance: 35.

Case Institute of Technology, Jan. 10. Election of officers. Speech contest in preparation for the annual Case-Fenn speech contest to be held in Cleveland Engineering Society Hall.

University of Cincinnati, Jan 13. Speaker: R. H. Kellogg. Subject: Opportunities for the Young Engineer in the Procter and Gamble Company. Attendance: 106.

Colorado A and M College, Jan. 11. Business meeting. Film: A Hidden World. Attendance: 40.

Jan. 18. Speaker: Mr. Fisher. Subject: Mechanical Equipment in the Sugar-Beet Industry. Film: Today in the Sugar-Beet Industry. Business meeting. Attendance: 36.

Feb. 1. Business meeting. Film: Nickel and Nickel Alloy. Attendance: 74.

University of Connecticut, Jan. 11. Speaker: Professor Z. R. Bliss. Subject: Presentation of Charter. Attendance: 70.

Cooper Union (Evening), Jan. 5. Speaker: G. G. Ross. Subject: Stroboscopic Instruments in Engineering. Attendance: 25.

Cornell University, Jan. 19. Speaker: Dean D. S. Kimball. Subject: Historical Story of Cornell. Attendance: 80.

Penn College, Jan. 20. Election of officers. Film: Atomic Power. Attendance: 72.

University of Florida, Jan. 10. Film: Copper Mining. Attendance: 157.

George Washington University, Jan. 4. Speaker: Dr. Avery. Subject: Guided Missiles. Attendance: 25.

Georgia Institute of Technology, Nov. 1. Bell Telephone Company films shown.

Nov. 8. Speaker: H. L. Bowen. Subject: Management's Viewpoint on Labor Problems.

Nov. 15. Speaker: L. K. Silleox. Subject: Hauling Horsepower.

Nov. 22. Speaker: Glen Farrar. Subject: Power by Which We Live.

Nov. 29. Film: Magic Wand of Industry.

Dec. 6. Election of officers.

State University of Iowa, Jan. 4. Speaker: Professor R. L. Sutherland. Attendance: 100.

Jan. 11. Speaker: A. A. Alexander. Subject: General Construction in Industry. Attendance: 185.

Jan. 18. Speaker: Professor C. H. Menzer. Subject: Operation Sandstone. Attendance: 101.

Jan. 25. Speaker: Dean J. F. Downie Smith. Subject: Rubber Springs. Attendance: 270.

Johns Hopkins University, Jan. 9. Speaker: F. H. Clauser. Talk on relative speeds obtained by man so far, and possible methods of obtaining even greater speeds. Attendance: 43.

Jan. 16. Tour through the newly constructed supersonic wind tunnel on the campus. Attendance: 60.

Kansas University, Jan. 12. Speakers: Messrs. Cotter, Bateman, Atherton, and Holzbouer. Subject: Job Opportunities. Attendance: 76.

Lafayette College, Jan. 12. Speaker: William Boyle. Subject: Aircraft Gas Turbines and Jet Propulsion. Attendance: 65.

Louisiana Polytechnic Institute, Jan. 10. Election of officers and business meeting. Attendance: 36.

University of Louisville, Jan. 26. Films of Dielectric and Inductance Heating. Attendance: 108.

Marquette University, Dec. 6. Election of officers. Attendance: 40.

Jan. 12. Film: Principles of Refrigeration. Attendance: 45.

Jan. 26. General business meeting. Attendance: 80.

University of Michigan, Jan. 4. Speaker: J. K. Salisbury. Subject: Process Engineering. Attendance: 137.

Jan. 18 and 19. Field trip to the Great Lakes Steel Plant, Ecorse, Mich. Attendance: 51.

Michigan State College, Jan. 18. Speaker: Roger Bollier. Subject: Gear Hobbing. Attendance: 75.

Jan. 24. Special meeting. Attendance: 50.

Feb. 1. Speaker: Mr. Burstadt. Subject: Turbines, illustrated with films. Attendance: 103.

Michigan College of Mining and Technology, Jan. 10. General business meeting. Attendance: 40.

Jan. 24. General business meeting. Speaker: Mr. Niemi. Subject: Professional Society Membership. Attendance: 42.

University of Minnesota, Jan. 11. Speaker: L. Whitson. Subject: The Industrial Engineer at Work in Industry; and Future Plan for Industrial Engineering Courses at the University. Attendance: 43.

Mississippi State College, Jan. 12. Election of officers for spring semester. Attendance: 27.

Montana State College, Jan. 18. Business meeting. Attendance: 58.

Feb. 1. Showing of films. Attendance: 44.

University of Nevada, Dec. 7. Film: Fluid Drive. Attendance: 32.

University of New Hampshire, Jan. 9. Film: By Their Works. Attendance: 65.

New Mexico College of A and M Arts, Jan 5. Talks by seven senior students. Attendance: 31.

University of North Dakota, Jan. 10. Election of officers for spring semester. Films: Operations Crossroads; Hidden World. Attendance: 64.

Northeastern University, Jan. 5. Speakers: W. Riddle, W. Rigby, K. Wood, and H. Zeltzer. Attendance: 25.

Northwestern University, Jan. 17. Film: Tornado in a Box. Attendance: 38.

Norwich University, Jan. 11. Speaker: F. M. Gunby, vice-president, ASME Region I. Subject: A welcome to the new student branch, and talk on the advantages of being associated together.

University of Notre Dame, Jan. 12. Election of officers. Attendance: 38.

Ohio State University, Jan. 19. Speaker: Robert Ogg. Subject: Patents. Attendance: 73.

University of Oklahoma, Dec. 7. Speakers: C. C. Willis and J. W. Blake. Subject: Gas-Turbine Installation at the Huey Station of the Oklahoma Gas and Electric Corp. Attendance: 52.

Dec. 20. Speaker: R. S. Ogg. Subject: Diesel Engineering. Attendance: 43.

Pennsylvania State College, Jan. 12. Speaker: F. R. Wodtke. Subject: Opportunities Afforded Present-Day Graduates in Engineering. Attendance: 70.

University of Pittsburgh (Mechanical Division), Jan. 5. Speaker: L. W. Johnston. Subject: Politics and the Engineer. Attendance: 169.

Jan. 12. Speaker: L. E. Endsley. Subject: The Engineer's Place in the Railroad Industry. Attendance: 169.

Jan. 19. Election of officers. Attendance: 169.

Purdue University, Jan. 10. Speaker: E. B. Newill. Subject: Opportunities for Graduate Engineers in the Field of Gas Turbines. Attendance: 195.

Rhode Island State College, Jan. 5. Speaker: M. Judkins. Subject: Powder Metallurgy. Attendance: 55.

University of Rochester, Dec. 15. Christmas party, preceded by business meeting. Attendance: 31.

Jan. 5. Speaker: G. F. Akins. Subject: Process Instrumentation in Process Control. Attendance: 48.

Rutgers University, Jan. 5. Election of officers. Attendance: 25.

University of South Carolina, Jan. 3. Business meeting and plans made for field trip. Attendance: 53.

Jan. 17. Election of officers for spring semester. Attendance: 44.

University of Southern California, Nov. 23. Speaker: Wally Linville. Subject: Fuels and Lubricants. Attendance: 40.

Nov. 29. Speaker: David Warner. Subject: Rockets. Attendance: 125.

Jan. 11. Election of officers and prospectus for next semester. Attendance: 60.

University of Tennessee, Jan. 18. Film: Diesel Power. Attendance: 49.

Feb. 2. Speaker: Dean N. W. Dougherty. Subject: State Registration for Engineers. Attendance: 39.

Tufts College, Jan. 17. Speaker: E. M. Wilkins. Subject: Industrial Safety. Attendance 21.

U. S. Naval Academy (Midshipman School), Dec. 21. Two films: The Navy's First Plastic Boat; Construction Operations in the Arctic. Attendance: 250.

Feb. 1. Speaker: Capt. A. A. Nichoson. Subject: Engineering—The Mainspring of the American Way. Attendance: 60.

University of Utah, Dec. 6. Speaker: J. Calvin Brown, past-president, ASME Region VII. Subject: Perpetual Motion. Initiation of Mr. Brown as honorary member to Utah Pi Xi Chapter of Pi Tau Sigma.

Vanderbilt University, Dec. 7. Official business meeting. Attendance: 40.

Jan. 18. Speaker: Blanton Duncan. Subject: Summer Jobs in Civil Service. Attendance: 30.

Feb. 1. Speaker: W. R. Green. Subject: The Job Outlook. Attendance: 30.

Virginia Polytechnic Institute, Jan. 17. Film: Money at Work. Attendance: 75.

Jan. 24. Speaker: H. G. Goodykoontz. Subject: The Fear of the Lord Is the Beginning of Religion. Attendance: 50.

Washington State College, Jan. 5. Nomination of officers for new semester. Attendance: 19.

Washington University, Jan. 10. Film: History of Aluminum Processing. Attendance: 44.

Wayne University, Jan. 4. Speaker W. A. Turunen. Subject: The Gas Turbine in Relation to the Automobile. Attendance: 47.

University of Wisconsin, Jan. 5. Speaker: Bill Brenand. Film: Cleveland Air Races. Attendance: 75.

Worcester Polytechnic Institute, Dec. 13. Speaker: George Crompton, Jr. Subject: Patent Law. Presentation of chapter charter.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after March 25, 1950, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

ABBOTT, W. B., Springfield Gardens, N. Y.
ADAMS, JOHN K., Charlotte, N. C.
ALLEN, WILLIAM F., Jr., Boston, Mass.
BALCONI, PAUL M., Houghton, Mich.
BARROW, A. B., Woodland, Calif.
BATEMAN, WILLIAM M., Toronto, Ont., Can.
BERNGARD, JACK J., Chicago, Ill.

1950 ASME Regional Student Conferences

Region	Host	Place	Date
I New England	Rensselaer Polytechnic Institute	Troy, N. Y.	April 21–22
II Eastern	New York University (Day and Evening Branches)	New York, N. Y.	April 22
III Alleghenies	U. S. Naval Academy Midshipman School	Annapolis, Md.	April 14–15
IV Southern	Clemson College (Concurrent with Region IV Administrative Committee Meeting)	Clemson College, S. C.	April 7–8
V Midwest	Carnegie Institute of Technology, University of Pittsburgh (Concurrent with Pittsburgh Mechanical Engineering Conference)	Pittsburgh, Pa.	April 24–26
VI Northern Tier	South Dakota State College	Brookings, S. D.	To be set
VI Southern Tier	University of Kentucky	Louisville, Ky.	April 20–21
VII Pacific Northwest	University of British Columbia	Vancouver, B. C.	May 4–6
VII Pacific Southwest	University of Santa Clara	Santa Clara, Calif.	April 14
VIII Northern	Kansas State College	Manhattan, Kans.	May 12–13
VIII Southern	Southern Methodist University (Concurrent with the Biennial ASME Regional Meeting and Region VIII Administrative Committee Meeting)	Dallas, Texas	March 31–April 1
VIII Rocky Mountain	New Mexico College of Agriculture and Mechanic Arts	State College, N. M.	April 24–25

BERNSTEIN, ARTHUR GEORGE, New York, N. Y.
BISHOP, GEORGE W., Baltimore, Md.
BLYLER, PAUL DANIEL, Lykens, Pa.
BOOTHROYD, EDWIN P., Phoenix, Ariz.
BRANDWINE, MILTON D., St. Louis, Mo.
BRENTON, RICHARD F., McGill, Nev.
BRUSDAL, OLAF, Scotia, N. Y.
BURNHAM, MARK B., Savannah, Ga.
CABANES, C. A. M., Asnières, Seine, France
CAPLAN, LOUIS ROSENBERG, Takoma Park, Md.
CARRON, THEODORE J., Detroit, Mich.
CHANE, GEORGE W., New York, N. Y.
CLEMENTS, THEODORE CLARK, New York, N. Y.
COHEN, LAWRENCE B., New York, N. Y.
CRAIG, J. M., Mount Holly, N. C.
DACK, W. S., Lakewood, Ohio
DAVIS, WENDELL, Storrs, Conn.
DAWSON, R. A. J., Houston, Texas
DE SOLA, ROMAN D., Caracas, U. S. of Venezuela, S. A.
DOBLER, CHARLES I., Baltimore, Md.
DONAHUE, JAMES E., Swarthmore, Pa.
DUNNING, JOHN RAY, New York, N. Y.
EHINGER, WILLIAM C., Tiffin, Ohio
EVANS, WILLIAM R., Flushing, N. Y.
EYSTER, JOHN L., Phillipsburg, N. J.
FARKAS, ANDREW G., New York, N. Y.
FROBE, RAYMOND WILLIAM, Malvern, Ark.
FROHMAN, OSCAR, Milwaukee, Wis.
GARDNER, GEORGE F., Scotia, N. Y.
GEARHART, RUSSELL VERNON, Provo, Utah
GEORGIA, EDWARD J., Stanford, Calif.
GERY, RALPH C., Indianapolis, Ind.
GILLESPIE, H. G., JR., Roanoke, Va.
GILMORE, DONALD EDWARD, Raritan, N. J.
GODWIN, ROBERT A., Philadelphia, Pa.
GRAY, IAN A., Vancouver, AMF. B. C., Can.
GREIS, HOWARD A., Lynbrook, N. Y.
GRIFFIN, JOHN R., JR., Bridgeport, Pa.
GRIMPE, WERNER A., Point Pleasant, W. Va.
GUENTHER, OTTO V., Buffalo, N. Y.
GUPPY, WILLIAM H., Dixon, Ill. (Rt. & T.)
HANDLEY, LAUREN, Berkeley, Calif.
HARDY, JOHN W., Pointe-à-Pierre, Trinidad, B. W. I.
HEATH, W. C., La Mesa, Calif.
HESSELBERG, E. H., San Francisco, Calif.
HOLM, OVE F., Sunbury, Pa.
HUDSON, JAMES I., Wilmington, Del.
HUGHES, R. W., Wilmington, Del.
HUNGER, ROBERT F., Haverford, Pa.
HUNT, F. E., Kansas City, Mo.
HUNT, PERCIVAL REYNOLDS, Milton, Mass. (Rt & T)
JACKMAN, JOHN T., JR., Englewood, N. J. (Rt & T)
JANOWITZ, ROBERT, Kansas City, Mo.
JONES, F. CHANDLER, JR., Ardmore, Pa.
JORISSEN, ANDRE L., State College, Pa.
KACZMAREK, LEO WALTER, Chicago, Ill.
KAMMERER, PAUL, Newington, Conn.
KESTEN, MARTIN, Hartford, Conn.
KEUNE, ERNEST H., Cincinnati, Ohio
KINGHORN, EDWARD H., Collingswood, N. J.
KROMP, CARL, Terre Haute, Ind.
LANGDON, JOHN T., Laramie, Wyo.
LAUDIO, JAMES J., Scranton, Pa.
LINDSEY, JOHN, 3RD, Laurel, Miss.
LINLEY, FREDERICK H., JR., New York, N. Y.
MATHIAS, WALTER J., Schenectady, N. Y.
MCGRAW, HAROLD M., White Oak, Silver Spring, Md.
MCKNIGHT, W. H., JR., Corning, N. Y. (Rt & T)
MEYER, RANKIN D., Philadelphia, Pa.
MILLER, ARTHUR J., New Britain, Conn.
MINGLE, J. G., Indianapolis, Ind. (Rt)
MOLNAR, CHARLES, E. Chicago, Ind.
MONAHAN, HAROLD E., Sr., Philadelphia, Pa.
MONTVEDAS, JOSEPH P., Chicago, Ill.
MORIARTY, CHAS. D., Schenectady, N. Y.
MORSE, R. L., Eureka, Pa.
MOSKOWITZ, DAVID, Los Alamos, N. M.
MURPHEY, ROBERT P., Alameda, Calif.
NARDIN, WALLER HUNN, Greenville, S. C.
NELSON, CHARLES WILLIAM, San Carlos, Calif.
NEWMAN, LOWELL M., Excello, Ohio
NORTHCOTT, ELLIOTT, 2ND, Holden, W. Va.
NORTHROP, JOHN K., Hawthorne, Calif.
OELKERS, ALBERT L., Chicago, Ill. (Rt & T)
OLIN, ROBERT, New Hyde Park, N. Y.
OWENS, BERL F., Seattle, Wash.
PERKINS, ALLEN L., Milwaukee, Wis.
PETERSON, CARL D., JR., Watertown, Conn.
PREVATT, J. D., Florence, S. C.
RAMSAY, J. WILKIE, Montreal, Que., Can.
RIDENOUR, WAYNE L., Chicago, Ill.
REED, J. C., Harrods Creek, Ky.
RIGGIO, VINCENT J., Elizabeth, N. J.
SCHINDLER, FREDERICK C., Petrolia, Pa.
SCHWAB, JOHN L., Easton, Conn.
SENUTA, DONALD, Akron, Ohio
SHIMEK, CHARLES, Chicago, Ill.
SIEG, LAWRENCE ORISON, Kingsport, Tenn.
SINGLETON, BENOIT MILLARD, Marshall, Mich.
SLONNEGER, ROBERT D., Austin, Texas
SMITH, LLOYD W., Toledo, Ohio
SMITH, RICHARD EARL, Philadelphia, Pa.
SPRETER, ROY P., Philadelphia, Pa.
STANTON, WM. M., Schenectady, N. Y.
STONE, VERN L., Chicago, Ill.
STOREY, BRADFORD G., Glenside, Pa.
STRASSER, DALE M., Whittier, Calif.
STUART, ALFRED I., Portland, Ore.
SUTERMEISTER, ARNOLD K., New York, N. Y.
TAYLOR, J. J., Floral Park, N. Y.
TAYLOR, ROBERT L., Richmond, Va.
ULMANN, H., Montreal, Que., Can.
UNER, RIDVAN ALI, E. Peoria, Ill.
WEBB, J. IRVIN, Munhall, Pa.
WHEELER, ROY L., Pittsburgh, Pa.
WILSON, R. B., Jackson, Miss.
WILSON, ROBERT H., Pittsburgh, Pa.
WINTERS, JOHN M., Altadena, Calif.

CHANGE IN GRADING

Transfers to Member and Associate

BIBES, G. R., New York, N. Y.
DOERR, NORMAN E., Melrose Park, Ill.
DUFFY, EDWARD C., Floral Park, N. Y.
EDWARDS, WILLIAM R., Baytown, Texas
ERICKSON, ARNOLD CARL, Ridgewood, N. J.
FINNERAN, J. E., JR., Columbus, Ohio
GROSSMAN, NICHOLAS, Cambridge, Mass.
HARRIS, WILLIAM B. D., JR., Doylestown, Pa.
HOFSTEIN, LAWRENCE L., New York, N. Y.
KEPPLER, PAUL WILLIAM, Sea Bright, N. J.
KNABE, FREDERICK SMITH, Baltimore, Md.
KRAUTH, JOSEPH ANTHONY, Seattle, Wash.
LAND, GEORGE W., Madisonville, Ky.
NORDEEN, FRANCIS WM., St. Paul, Minn.
RIESTER, ROBERT A., Irwin, Pa.
SAMMIS, EDWARD A., Roslyn Heights, N. Y.
SANDERS, LEON H., Barberton, Ohio
SHERMAN, WARREN S., JR., Oklahoma City, Okla.
SMITH, JOHN W., Detroit, Mich.
TAYLOR, WARREN F., Chicago, Ill.
VOGEL, RAPHAEL, New York, N. Y.
WERLEY, HARLAN R., Haddon Heights, N. J.
WITHERSPOON, D. L., Anchorage, Ky.

Transfers from Student Member to Junior 327

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a non-profit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, 23, graduate, BME, single. Georgia Tech, Pi Tau Sigma. Some managerial training. Desires position with future in production or development. New York, New Jersey, or Connecticut. Me-629.

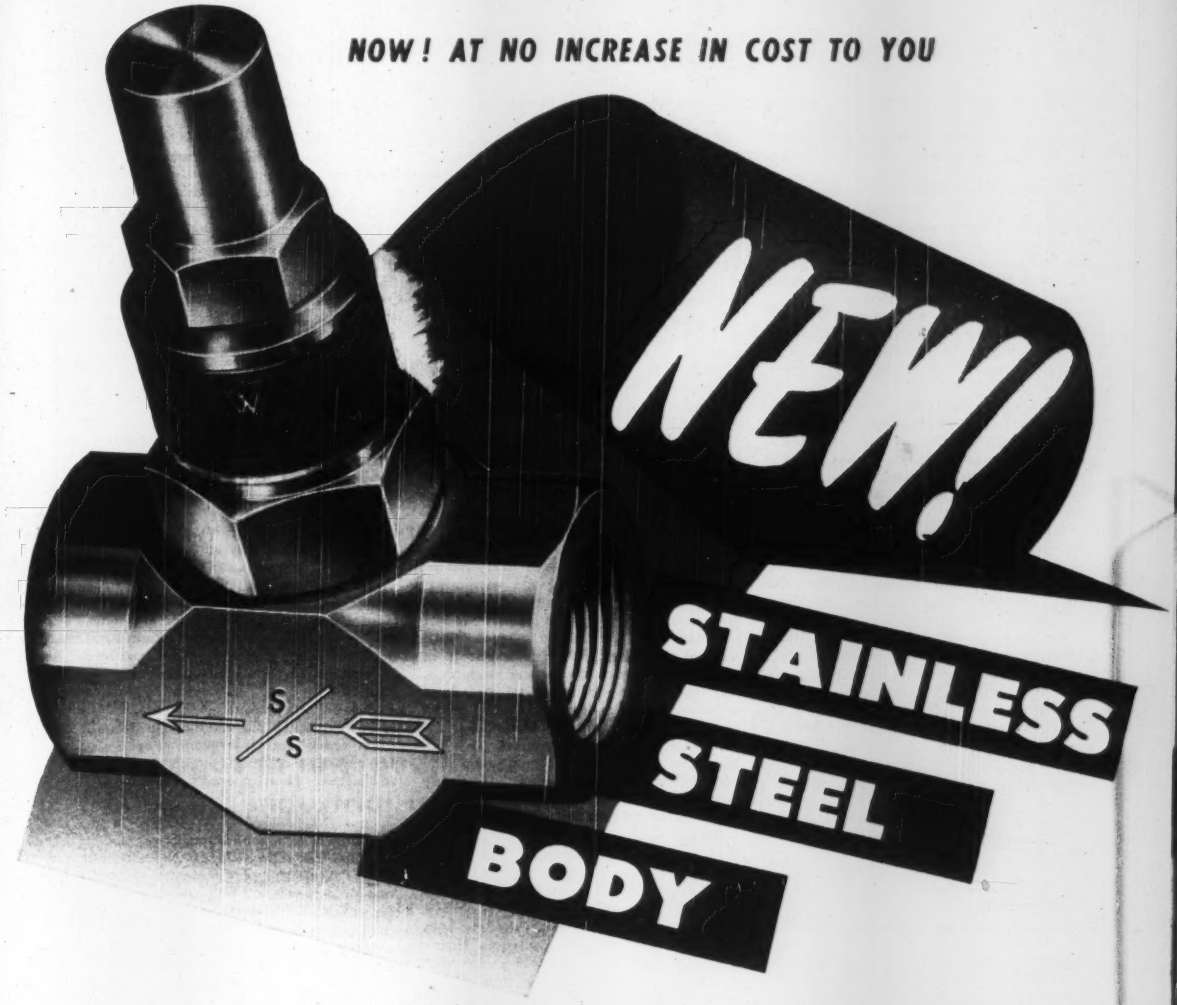
MECHANICAL ENGINEER, BSME, University of Connecticut, 1949, 25, married, Tau Beta Pi. Currently employed aircraft industry; six months' experience jet-engine research. Holds marine license as second mate, unlimited. South America, preferably Brazil. Me-630.

HYDRAULIC ENGINEER, PE, New York State;

[1] All men listed hold some form of ASME membership.

(*ASME News continued on page 278*)

NOW! AT NO INCREASE IN COST TO YOU



Makes a good steam trap better

Nearly 650,000 Yarway Impulse Steam Traps have already been installed—proof that they are doing a good job.

Now a *stainless steel* body makes this famous little trap even *better—at no increase in cost.*

Better in *wear*, better in *service*. Users will find Yarways require less maintenance than ever. All parts are wear-resistant, practically wear-proof. There is only one moving part, a small, stainless steel, heat-treated valve. Important, too—Yarway Impulse Traps are *suitable for all pressures up to specified maximum without change of valve or seat.*

Other popular advantages are *small size, light weight, easy installation* and *low cost.* Often it costs *less* to buy a new Yarway trap than to repair an old, ordinary trap.

In performance—ask any user. They all say Yarways are the traps that *get equipment hotter sooner and keep it hot!*

For better steam trap performance, try *new* stainless steel Yarways.

YARWAY IMPULSE STEAM TRAPS ARE SOLD BY OVER 200 DISTRIBUTORS. THERE IS ONE NEAR YOU.

Write for name and address.

YARNALL-WARING COMPANY
108 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

BS, MSCE; 30, married; eight years' experience hydraulic engineering and research, including three years' consulting work and design and development of hydraulic laboratories. Me-631.

MECHANICAL AND AERONAUTICAL ENGINEER, BME, Cornell; MS, Aero Engineering, Harvard; three years' experience in research and development; good analytical and experimental background; worked with compressible flow and SR-4 strain gages. Desires work with fluid-flow problems. Me-632.

RECENT GRADUATE, mechanical, 22, single, Stevens Institute of Technology. Qualified for development, design work. Desires packaging industry, container industry. United States. Me-633.

MECHANICAL ENGINEER, BSME, PE, 31. Seven years in chemical industry. Plant layout, piping, pressure vessels, mechanical equipment, machine design, project preparation, and estimates. Employed at present in W. Va. Will relocate for opportunity. Me-634.

SALES ENGINEER TRAINEE, single, 26, BSME. Now employed by major oil company as junior petroleum engineer, with seventeen months' experience. Licensed marine engineer. Desires technical sales position. Location, Southwest. Me-635.

MECHANICAL ENGINEER, 28, married, BSME. Graduate work in applied mechanics. Eight years' experience toolmaking, tool fixture, and machine design. One year project engineer on air-borne-equipment development and design. Eastern location preferred. Me-636.

MECHANICAL AND CIVIL CONSULTANT, fully qualified to conduct expansion, reconstruction programs, involving mechanical equipment, piping structural steel. Excellent record surveying industrial plants, making reports, developing, and producing complete projects. Me-637.

MECHANICAL ENGINEER, 29, BME. Desires design position leading to methods study. Two years adjusting computing equipment. Five years design and supervising fabrication on boiler components. Upstate New York. Me-638.

MECHANICAL ENGINEER, 25, BS, 1947, married. Three years' machine-drafting experience and other engineering-department duties. Desires position in sales, development, testing, or maintenance. Eastern location. Me-639.

MECHANICAL ENGINEER, BME, recent graduate, 22, single. Desires any position with future. Will travel or locate anywhere. Me-640.

MECHANICAL ENGINEER, PE, 35, registered in New York and California. Graduate major university. Ten years' experience in stress analysis, materials engineering, including elevated-temperature problems, mechanical and structural design, static and vibration testing. Desires employment in these or related fields of applied mechanics for research, design, teaching, or analysis. Me-641-501-D-3.

MECHANICAL ENGINEER, 42, married, BSCE, BSME. Fifteen years' experience in heating, refrigeration, air conditioning, and low-pressure pneumatic conveying. Duties covered research and development, system design, estimating and erection. Registered professional engineer. Available immediately. Will locate anywhere. Me-642.

MECHANICAL ENGINEER, graduate, 25, Navy veteran. One year machinist, six months drafting experience, knowledge multislide machines. Desires work in metalworking or plastics industry. New York, N. Y., or vicinity. Me-643.

MECHANICAL ENGINEER, recent graduate, no experience. Interesting eight-year background in precision optics and fire control. Some electronics. Will relocate. Me-644.

METHODS ENGINEER, mechanical graduate, ten years' experience, including extensive development lower-cost production methods, motion study, assembly fixture design, machine and workplace layout, preparation of savings, estimates, and process sheets. Me-645.

EXECUTIVE, mechanical degree, twenty-five years' experience in staff and line positions, co-ordinating engineering and production in heavy industry. Wants responsibility. Married, two children. Presently employed. Me-646-169-ME.

MECHANICAL ENGINEER, BME, June, 1949, graduate, NYU, six months' drafting and design experience in heating and ventilating. Desires position with future in design of process machinery or power plants. Me-647.

MECHANICAL ENGINEER, 26, married, BSME from M.I.T. Over two years' experence in research, small-parts design and production, and maintenance. Interested in research of production work in Rocky Mountain region or San Francisco Bay area. Me-648.

ENGINEER, mechanical-electrical, with sixteen years' experience in chemical plant, layout, construction, and utilities. Currently engaged as construction engineer in charge of design and construction. Me-649.

RECENT GRADUATE, 27, married, veteran, with machine-shop background. Desires position as junior engineer or draftsman with company offering opportunity for advancement. Me-650.

MECHANICAL-ENGINEERING GRADUATE, 1943, Tau Beta Pi, 28. Design, calculations, testing, power plants, and machine-shop experience. Can meet and supervise people. Employed but must relocate in Baltimore, Md., or vicinity. Me-651.

MECHANICAL ENGINEER, 26, recent graduate, mechanical and commercial background. Will relocate. Any offer considered. Me-652.

MECHANICAL ENGINEER, January, 1950, graduate, age 25, ex-Air Force Officer. Was apprentice tool die maker. Assisted manufacture of jigs, fixtures, tools, dies. Good knowledge machine tools, shop methods. High academic standing. Me-653.

MECHANICAL ENGINEER, high class standing. Machine shop, machine and die design experience. Completed part of requirements for master's degree in machine design. Desires position in production or machine design. Me-654.

MECHANICAL ENGINEER, BS, graduate of General Motors Institute of Technology. Eighteen years' experience as plant engineer, master mechanic, and industrial engineer. Thorough knowledge of heavy industry and machining operations and gray-iron foundry, construction, and municipal projects. Knowledge of French and Spanish. Willing to travel. Available now. Me-655.

MECHANICAL ENGINEER, 31, married, BME, Minnesota, registered. Eight years' experience as sales engineer for one of the largest heavy-machinery manufacturers in the country. Interested in sales engineering or plant engineering in Midwest. Available now. Me-656.

RECENT GRADUATE, MSME, M.I.T.; MBA, Columbia; Sigma Xi, 26, single. Knowledge of several languages; engineering experience in telephone company. Desires to combine engineering and business training. Travel no problem. Me-657.

PLANT ENGINEER, 34, BSME, graduate work in management, licensed PE in N. Y. and N. J., ten years' diversified experience in process industry and allied equipment involving administration, maintenance, and design. Location, open. Me-658.

INDUSTRIAL ENGINEERING GRADUATE, 1949, age 26, single, planning, production control, co-ordination, methods, blueprint, drafting. Air Force electrical mechanic. Position with future first consideration. Me-659.

ENGINEER, 38, registered, fourteen years' experience, machine, tool, process design. Head plastics development, testing, application, design. Plant engineer, water treatment, steam and power generation. Executive level position desired. Philadelphia preferred. Me-660.

MECHANICAL ENGINEER, 24, married, BSME, 1949; MS June, 1950. Available for work in steam turbine, or power-plant design. One year experience drafting room, elevator design, and layout. Location open. Me-661.

POSITIONS AVAILABLE

MASTER MECHANIC for manufacturer of a line of simple dry cells. Will be responsible for general supervision of a toolroom and maintenance department. Will co-ordinate these departments with production and industrial engineering in order that a mechanization program may be carried out. Will be responsible for toolmaking and liaison with vendors when tools are purchased. Responsible for maintenance of all equipment and property, etc. Should have toolroom and maintenance experience, and should be a capable toolmaker. $5000. Upstate New York. Y-3162.

APPLICATION ENGINEER, 28-35, mechanical graduate, preferably specializing in heat power with steam-equipment experience, preferably valves and instruments, and should know the characteristics of steam and gases. Will help in preparing engineering summaries of project developments both for sales use and instructions for operation. Will determine means of applying products to particular installations. Some traveling. $4200-$5000. Pennsylvania. Y-3176.

DESIGNER, 40-50, mechanical graduate, to design and detail automatic machinery from sketches, and prepare estimates and specifications covering manufacturing equipment. $5000. Metropolitan New Jersey. Y-3183.

CHIEF ENGINEER, mechanical graduate, with specialized training in hydraulics and at least five years' experience in designing centrifugal

(*ASME News continued on page 280*)

FRESH OUT OF AIR, SIR?

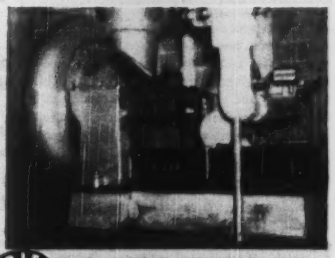
Call on *R-C dual-ability* to move air or gas in any quantities for industrial uses

When you have a job of handling gas or air, in quantities from 5 cfm to 100,000 cfm, Roots-Connersville will do it efficiently and economically. With many sizes and types, we can match blowers, exhausters and gas pumps closely to the job, to reduce first cost and operating costs.

R-C *dual-ability* offers you the exclusive, *dual* choice between Centrifugal and Rotary Positive designs. You can select single-stage or multi-stage units, from our standard lines, with flexibility as to drives and other accessories to meet your needs.

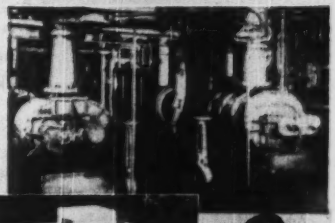
To aid in your specifications, our air-and-gas specialists are at your service. With nearly a century of experience behind them, they can help you solve almost any problem of handling air or gas.

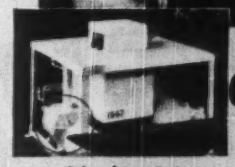
ROOTS-CONNERSVILLE BLOWER CORPORATION
503 Michigan Avenue, Connersville, Indiana



CENTRIFUGAL

Type OIB Centrifugal Blower in food processing plant. Capacity 12,000 cfm. One of several recent installations for this same company in other plants.





ROTARY

(Above) Installation of 4 Type RCB Gas Pumps, used in the manufacture of dry ice in large midwestern plant. Capacity of each pump is 5,370 cfm.

(Below) Small Rotary Positive Blower built into forge for maintenance service.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

DOING ONE THING WELL FOR ALMOST A CENTURY

pumps, to design centrifugal pumps and supervise detailing and technical correspondence in connection with sales. $6000 plus bonus. Midwest. Y-3199.

ASSISTANT TO THE PRESIDENT, 40–45, with good background in general business, accounting, and sales. Company manufactures heavy machinery. $12,000–$15,000. New York, N. Y. Y-3206.

ENGINEERS. (*a*) Chief engineer, 40–45, to take complete charge of all design and development work for company manufacturing heavy high and low-speed rotary machinery. Must know shop practice and be a good administrator. $12,000–$15,000. (*b*) Assistant chief engineers, 2; one experienced in high-speed machinery, and the other on low-speed, heavy, process mill equipment. Salaries open. New England. Y-3210.

RESEARCH ENGINEER, mechanical, with some design experience in pneumatic transmission instruments, such as record controls for process industries. $5000–$6000. Eastern Pennsylvania. Y-3216.

CHIEF ENGINEER with master's degree in mechanical engineering, and at least ten years' industrial experience in the design of electromechanical apparatus. Ability to design electromechanical equipment in accordance with specifications and features provided by research and sales departments. Ability to supervise and co-ordinate the activities of a diversified engineering department. Ability to set up and maintain adequate design and drafting schedules to insure efficient engineering development and complete production or procurement drawings. $7000–$9000. Kentucky. Y-3219.

ENGINEERS. (*a*) Factory manager, 35–50, with degree in chemical or mechanical engineering. Should have ten years' experience in supervision of mechanical rubber goods, familiar with all phases of rubber production, experience in mandrel building and splicing operations. Thorough knowledge of mold design desirable. Thorough knowledge of production control, process control, and production planning desirable. $6000–$10,000. California. (*b*) Assistant general manager, 35–40, mechanical degree, experienced in manufacturing metal punch press, supervision of several departments, production, production control, purchasing, inventory control, inspection, labor relations, personnel, cost accounting, budgets. $8000–$12,000. Ohio. Y-3240.

PRODUCTION ENGINEER, 30–35, mechanical graduate, with at least five years' supervisory experience in hardware, locks, and hydraulic devices, to plan production of door-closing devices, including purchasing, inventory, and quality control. Will also work closely with sales on special items. $5000–$6000. New York, N. Y. Y-3253.

TOOL DESIGNER, particularly familiar with jig and fixture design and who preferably has had actual shop experience; previous processing experience desirable for a manufacturer of air compressors and paint-spraying equipment. $3600–$5100. Wisconsin. R-6162.

SALES ENGINEER, mechanical or chemical graduate, 35–40, with extensive experience with water-treatment equipment (filters, clarifiers, hot and cold process); must be in large industrial-type equipment. Some selling experience in this area. In addition to water treatment will handle dust collectors, induced draft, stack equipment, and soot blowers for a manufacturer's representative. Salary open. Traveling. Headquarters, Illinois. R-6166.

MECHANICAL DESIGNER experienced in plant layout, process piping, conveyers, special machinery, and equipment. A group leader will be considered. Salary open. Ohio. R-6167(*b*).

PROJECT ENGINEER, 40–45, mechanical background, with extensive experience with tool and die design; previous benchwork as toolmaker desirable. Able to carry project through from inception to completion and to counsel and advise project engineers on their draftingboard work for a manufacturer of precision small products. $7000–$8000. Illinois. R-6185.

DESIGN ENGINEER, 32–48, mechanical graduate capable of supervising a design-engineering department including the preparation of drawings, bills of material, etc., of large heavy automatic machinery. $6600–$8400. Illinois. R-6188(*a*).

PLANT LAYOUT ENGINEER, up to 55, mechanical graduate, thoroughly experienced in arrangement and laying out of heavy plant equipment (drives, mills, conveyers, coolers, etc.) as encountered in grain elevators, cement plants, or similar bulk-handling installations. $6000–$6600. Illinois. R-6196(*b*).

DESIGN AND DEVELOPMENT ENGINEER, up to 40, mechanical graduate desired, with five or more years' experience in moderately heavy industry to design and develop special production equipment. Should have executive ability and experience in conveyerized plants for design and maintenance and installation for manufacturer of cathode-ray tubes. Salary open. Illinois. R-6212.

PACKAGING ENGINEER experienced with development design, specification of food containers, knowledge of working strength, paperboard and papermaking (solid, corrugated, and sheet); informed about type, sizes, basic weights, and tests of single and multiple bags and packaging. Will prepare suitable containers to satisfy customers shipping needs. $4800. Illinois. R-6220.

DESIGNER, mechanical graduate, with major in machine design, minor in refrigeration, several years' experience in creating machine design, making machinery layouts, stress and motion analysis, and cost analysis. Salary, up to $6000. Illinois. R-6222(*b*).

PLANT ENGINEER, mechanical graduate, thoroughly experienced in machine-shop supervision and equipment design. Knowledge of punch presses, roll threaders, galvanizing, wire drawing, and other general shop equipment. Will design and supervise substantial machinery-equipment program for a manufacturer with five factories. Able to organize, carry out, follow through, and complete program from start to finish on own responsibility, with minimum supervision. $4800–$7200. Illinois. R-6229.

ASME Master-File Information

Please Print — **Check Mailing Address**

Name ..... (Last, First, Middle)

Home Address ..... ☐ (Street, City, Zone, State)

Name of Employer .....

Address of Employer ..... ☐ (Street, City, Zone, State)

Product or Service .....

Title of Position Held .....

Nature of Work Done .....

I am a subscriber of (please check)

Transactions. . ☐ Journal of Applied Mechanics. . ☐ Applied Mechanics Review. . ☐

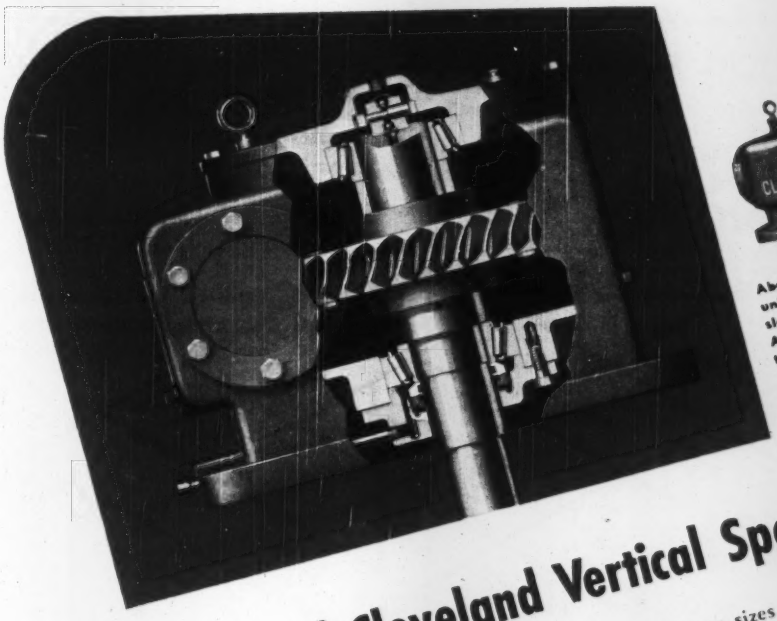
Notify Headquarters Promptly of Changes

Keep Your ASME Records Up to Date

HEADQUARTERS depends on its master membership file for answers to hundreds of inquiries daily pertaining to its members. All other Society records and files are kept up to date through changes processed through it. The listings in future ASME Membership Lists will be taken directly from the master file. It is important to you that it lists your latest mailing address and your current business connection.

The mailing form on this page is published for your convenience. You are urged to use it in reporting recent changes.

Your mailing address is important to Headquarters. Please check whether you want your mail sent to home or office address.



Above—Exterior view Type ND unit. NU unit (not shown) has slow-speed shaft extending up. At left—Cutaway section to show tapered roller bearings on gear shaft, positive face-type oil seal, unique lubricating pump and oil drain at base of housing.

A new series of Cleveland Vertical Speed Reducers

● NU and ND worm gear units—in seven sizes each (50 to 500) are ready for prompt delivery. They are particularly suited to such equipment as agitators and mixers, and for use in connection with supplementary low speed spur gear drives, without outboard bearings.

Outstanding features which insure that these new vertical drives will deliver long and trouble-free service are:

Extra heavy tapered roller bearings on gear shaft.

Continuous lubrication of top bearing by positively driven pump mounted on upper end of gear shaft (on lower end in Type NU).

Positive face-type oil seal below lower gear shaft bearing to prevent leakage.

Heavy base flange extends around all four sides. All parts liberally oversized and precision built.

Write for Bulletin 125 for full description of Types NU and ND, including capacity charts and dimension data. The Cleveland Worm & Gear Co., 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

JENKINS PRACTICAL PIPING LAYOUTS 48

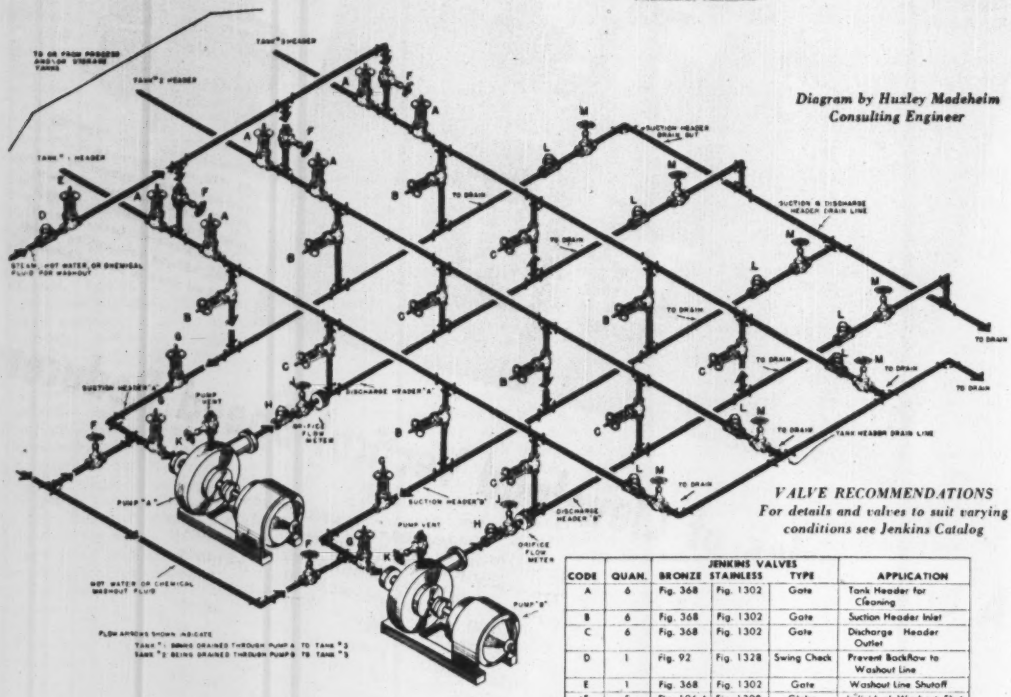


Diagram by Huxley Madeheim Consulting Engineer

VALVE RECOMMENDATIONS
For details and valves to suit varying conditions see Jenkins Catalog

CODE	QUAN.	JENKINS VALVES BRONZE	STAINLESS	TYPE	APPLICATION
A	6	Fig. 368	Fig. 1302	Gate	Tank Header for Cleaning
B	6	Fig. 368	Fig. 1302	Gate	Suction Header Inlet
C	6	Fig. 368	Fig. 1302	Gate	Discharge Header Outlet
D	1	Fig. 92	Fig. 1328	Swing Check	Prevent Backflow to Washout Line
E	1	Fig. 368	Fig. 1302	Gate	Washout Line Shutoff
F	5	Fig. 106-A	Fig. 1308	Globe	Individual Washout Shut-offs to Tank Headers
G	4	Fig. 368	Fig. 1302	Gate	Pump Suction Shutoffs
H	2	Fig. 92	Fig. 1328	Swing Check	Prevent Backflow to Pump
J	2	Fig. 106-A	Fig. 1308	Globe	Pump Discharge Control
K	2	Fig. 106-A	Fig. 1308	Globe	Pump Vent Control
L	7	Fig. 92	Fig. 1328	Swing Check	

CENTRAL PUMPING STATION FOR TRANSFER OF FLUIDS

In many industries transfer of fluids within a plant is a major operation. The flexible Pumping Station layout shown allows fluids to be pumped from tank to tank or to any processing equipment.

A single pipe line from each tank or piece of equipment is run to the pumping station and there connected to the suction and discharge headers of each pump. Adequate provision must be made for washing pumps, valves and pipe lines, since pollution of one fluid by the remains of a fluid previously pumped is often harmful.

This may be done by means of steam, hot water or chemical solutions, depending upon the fluids carried. Check valves should be installed on drain lines to prevent destructive backflow into the headers. The valve recommended for this layout is the Fig. 106-A, Jenkins Renewable Composition Disc. Bronze Globe Valve, which assures drop-tight closure.

Consultation with accredited piping engineers and contractors is further recommended when planning any major piping installation.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the Jenkins Catalog. It's your best assurance of *lowest cost in the long run.*

Jenkins Bros., 80 White St., New York 13.
Jenkins Bros., Ltd., Montreal.

Reserve your copy of NEW BOOK OF PIPING LAYOUTS Nos. 26 to 50

A new book of Jenkins Practical Piping Layouts—Nos. 26 to 50—including above, is in preparation. Mail coupon to get your copy when ready.

JENKINS BROS., 80 White Street, New York 13, N.Y.
Reserve copy of New Piping Layout Book for

Name .....

Company .....

Address .....

.....

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES SINCE 1864

• Keep Informed . . .

Announcements of current advertisers in MECHANICAL ENGINEERING and A.S.M.E. MECHANICAL CATALOG

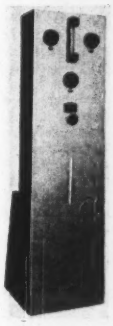
• NEW EQUIPMENT
• BUSINESS CHANGES
• LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as a source.

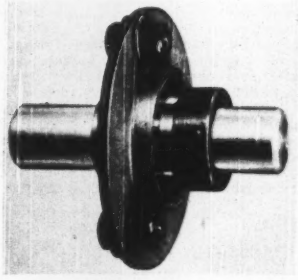
• NEW EQUIPMENT

Chlorine Feeder for Industrial Applications

Builders Chlorinizer for feeding chlorine gas has been designed with special attention to insure completely safe and highly accurate operation. It has been thoroughly field tested and numerous Industrial installations have been made. Chlorinizers are metering chlorine gas and producing closely controlled concentrations of chlorine water solution for process use, and are improving central by controlling slime and mussel growth. A positive and accurate chlorine rate indicator with direct reading linear scale assures equal ease and accuracy of readings at all rates. Maintenance due to corrosion is reduced to a minimum because Chlorine is controlled and metered in the dry, inert state. The feeder is readily adapted to semiautomatic, program or automatic proportional operation and conversion from one method of operation to any other may be made in the field. For bulletins, address Builders-Providence, Inc. (Division of Builders Iron Foundry), Providence 1, R. I.



The Flangette



Designed primarily for light duty, slow speed antifriction bearing applications, the Flangette has been developed by The Fafnir Bearing Co. It is described as a simple arrangement of two pressed steel stampings to form an inexpensive flanged housing enclosing a standard Fafnir self-aligning Wide Inner Ring type ball bearing. Light weight, low cost, factory sealed-in lubrication and ease of installation are listed as advantages of this complete ball bearing power transmission unit.

The Flangette is available for shafts of 18 sizes ranging from one-half inch to $2^{3}/_{16}$ inches. While developed primarily for the agricultural implement field, it is expected to find uses in such lines as light duty conveyors, dryers, tumbling barrels, food mixing equipment and many others, according to the manufacturer.

For a descriptive folder please contact: Truman L. Hunt, Advertising Manager, The Fafnir Bearing Co., New Britain, Conn.

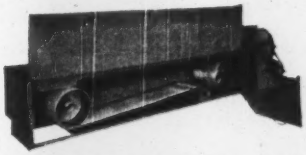
Fork Truck Aids Ambulance Crew, Handles Stretcher in Traffic Smash

When a truck overturned in a traffic collision near the Minneapolis-Moline Power Implement Co. plant in Minneapolis, a Clark fork truck was provided by the company as an aide in moving the victim. After firemen had carefully lifted the injured driver through the upper door of his wrecked vehicle, and onto a stretcher, the fork truck gently lowered the litter to the ground.

Extraordinary in their versatility, and ideal for countless "lifting" emergencies, fork trucks bring to the prosaic tasks of industry the same deftness with which, during the war, they transferred stretcher cases to planes for evacuation to hospitals.

New, Compact Belt Feeder Available

A compact, totally enclosed, yet fully accessible belt feeder for easy installation in tight places has recently been placed on the market by the Richardson Scale Co., Clifton, N. J.

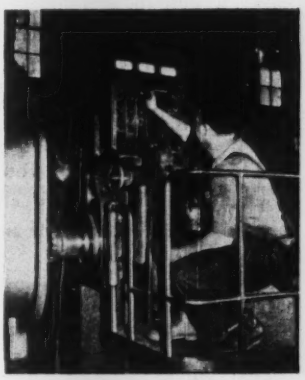


Originally designed to deliver a continuous stream of material from an intermittently discharging automatic bulk scale, this unit has a wide range of applications as a feeder or "take-away" conveyor. A variable speed drive can be furnished which is automatically adjustable to vary the stream in conformity with the timed discharges of the automatic scale above, and so maintain a continuous, accurately weighed stream. It also features cantilever pulleys for endless belting, removable skirt plates and streamlined appearance.

It is available in lengths of from 18 to 60 inches, and in stream widths of two, four and six inches with a rated capacity up to 1,500 cubic feet per hour. Belt speed is from zero to 200 feet per minute. It can be driven by a single speed motor at either end; from line shaft; or by special infinitely variable speed drive when specified. Manual control, or a special remote control up to 30 starts per minute is also available.

Further information on this feeder may be obtained by writing the manufacturer. Ask for Data Sheet No. 4915.

Feeds and Speeds Visibly Shown on Boring Mill

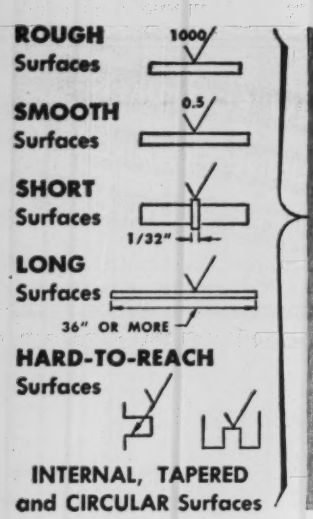


Machining is speeded and much guesswork is eliminated by the installation of the three Westinghouse tachometers showing feeds and speeds on this Model 570 Giddings and Lewis horizontal boring mill at the Sunnyvale, Calif., plant of the Westinghouse Electric Corp. By merely glancing at the dials located directly above the controls, the machinist can determine the revolutions per minute of the cutter shaft, the rate of feed, and the speed of the saddle.

Driven by Westinghouse a.c. motors, the mill shown here in the process of face milling a turbine exhaust cylinder is one of three similar machines in use at the plant.

By eliminating the need for end calculation by the machinist, and by providing him with fingertip control of the null operation, the instrument installations have been credited with effecting a substantial saving in milling time.

Continued on Page 40



. . . . You Can Measure Them ALL with the PROFILOMETER

In the Shop—in Definite Microinch Units

(Millionths of an Inch)

The Profilometer measures the roughness of nearly all surfaces produced by sizing and finishing operations—quickly, dependably, in the shop, in microinches r.m.s.

It *eliminates uncertainties* and differences of opinion common to "human" inspection methods; for it is a direct-reading *instrument,* as definite as a dial gage. It *saves time;* for it is the *fastest* means of getting roughness ratings. And with many common surfaces—such as small holes, recesses, deep bores, narrow bosses, and where *circular* tracing is required—it provides the only means for obtaining roughness ratings.

This fast and definite roughness measurement permits closer control of both product quality and production operations, with substantial savings in time and cost—on practically any part.

NEW FREE BULLETIN

gives the working range of the complete line of equipment, and shows typical applications. To see how the Profilometer meets YOUR needs, *write for Bulletin L-11!*

SEE THE PROFILOMETER IN USE

at Booth 233, ASTE Industrial Exposition, Philadelphia—or arrange for a demonstration in your plant.

Profilometer is a registered trade name.

PRC

PHYSICISTS RESEARCH COMPANY

Instrument Manufacturers

ANN ARBOR 6 • MICHIGAN

• Keep Informed

Ultrasonic Inspection of Crank Shaft

Ultrasonic inspection gave a clean bill of health recently to a 26-year-old diesel-engine crank shaft at the Perth Amboy Dry Dock Co., Perth Amboy, N. J. The test was made by Sam Tour & Co., Inc., New York City, with a Sperry Reflectoscope.

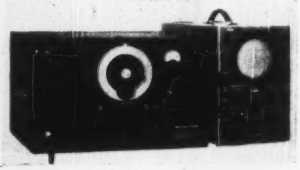
Twelve webs and the thrust disc of the crank shaft were inspected in the test. The webs, measuring 12½" by 18" by 4⅞", were tested by applying a searching unit to edges, sides and curved surfaces. The thrust disc, approximately 16" in diameter and 12½" thick, was tested from the periphery and sides. Ultrasonic vibrations were transmitted into the material and the reflections indicated on the cathode ray tube screen of the Reflectoscope. The relative positions of indications on the screen served to distinguish defects from oil holes, stud holes and edges of material, as well as to locate the defects in relation to the testing surface.

Generally, the crank shaft components were found to be free of defects which might reduce the strength of the shaft. Several minute defect indications were interpreted as forging ruptures. Two webs showed indications of larger, centrally located discontinuities. "Shots" were made from all surfaces to orient the defects and to establish their limits. The larger defects, because of their size and location were not believed to materially reduce the strength of the crank shaft. As a result of this test the shaft was returned to service.

The Rotalyzer

A new instrument, called the "Rotalyzer," is now available for measuring the average rotational speed of a shaft and indicating variations in speed vs time. A new method is used which provides unusual sensitivity and accuracy over a very wide speed range.

This instrument has been designed, engineered and manufactured by Kay Electric Co. of Pine Brook, N. J. Kay Electric is a well-known name in electronic, radio and television fields. They are noted for the manufacture of precision test equipment and laboratory instruments. One of their many instruments makes a visible record of speech or sound in relation to time and intensity.



The equipment, as supplied, includes the necessary pickup devices for attachment to the shaft, a cabinet containing the electronic amplifier and analyzer elements and an oscilloscope (modified Du Mont 304 H). The Rotalyzer may be purchased without oscil-

WORKS WHERE OTHERS WON'T

accurately formed

GRAPHALLOY OILLESS BEARINGS

SPECIFY GRAPHALLOY WITH CONFIDENCE

REG. U.S. PAT. OFF. TRADE MARK

SELF-LUBRICATING
EXTREMELY DURABLE
CONSTANT CO-EFFICIENT OF FRICTION
OPERATES DRY — OR SUBMERGED IN WATER, GASOLINE OR CORROSIVE LIQUIDS
APPLICABLE OVER A WIDE TEMPERATURE RANGE — even where oil solidifies or carbonizes
EXCELLENT AS A CURRENT-CARRYING BEARING.

GRAPHITE METALLIZING CORPORATION

1058 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

• Keep Informed

loscope and the customer's own sensitive d.c. coupled oscilloscope used for most work. The oscilloscope supplied is applicable to other general work.

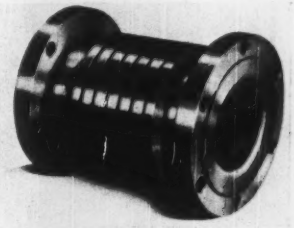
A high frequency magnetic disc and pickup are employed on the shaft to be measured. A very accurate tunable calibrated local oscillator is included to indicate average shaft rpm in conjunction with a null reading voltmeter. The oscilloscope indicates variations in speed in the vertical direction and time in the horizontal direction. By use of a suitable synchronizing or sweep signal proportional to shaft rotation the oscilloscope horizontal axis may be made proportional to shaft motion.

The standard speed range of the "rotalyzer" is 900 to 7200 rpm. This range may be extended upward to 50,000 rpm and downward to 33⅓ rpm on special order. Accuracy of 0.1% available over the speed range. Accuracies to .01% available at single speed in standard instrument.

Price: Rotalyzer without oscilloscope $825.00 F.O.B. Factory. Companion Oscilloscope $325.00 F.O.B. Factory. Prices slightly higher outside U.S.A. and Canada.

CMH Announces High Pressure Expansion Joints

Engineering and Operating personnel dealing with high pressure piping in industry's power and process fields will be vitally interested in the "Flexoniflex" line of Expansion Joints, announced by the Chicago Metal Hose Corp., 1305 South Third Ave., Maywood, Ill. These units for the 1,000 p.s.i. working pressure range, have been used successfully in critical confidential projects during the last several years. They are now available for use wherever gases or fluids must be conveyed under high pressures and between relatively moveable parts.



CMH Flexoniflex joints consist of corrugated, bellows-type, sections of stainless steel or other alloys formed within integral control rings and end sections. Unlike the control rings normally used on controlled-flexing expansion joints, the rings of Flexoniflex units are not bolted in place but have intimate relationship with the pressure carrier. This refinement of construction plus the design of the convolution wave and other highly engineered and carefully controlled manufacturing processes qualifies Flexoniflex units to withstand extremely high pressures. Research and development of this product was made in recognition of today's trend toward ever increasing pressures and temperatures in industrial power and processing activity.

Standard Flexoniflex joints are manufactured with single or multiple plies and may be lined or unlined depending on application. Sizes begin at ⅝" I.D. and continue through the range of extra high pressure pipe sizes. Temperature range is from sub-zero to 1400° F. for stainless steel. This upper limit can be exceeded with the use of special alloys.

Continued on Page 42

If your plant requires

- DIRECT HEATING OF VAPORS
- DIRECT HEATING OF LIQUIDS
- DOWTHERM INDIRECT HEATING
- STEAM GENERATORS
- STEAM SUPERHEATERS
- WASTE HEAT BOILERS

place the selection of the specific type in specialized hands . . . and obtain optimum efficiency.

Petro-Chem Development Company engineers are heating specialists . . . they can supply the whys and wherefores of indirect versus direct heating and the economics of both.

Every day more than 600, oil and gas fired, Petro-Chem Iso-Flow* installations in the petroleum, chemical and allied industries, demonstrate the efficiency of their design and installation.

***Patents issued and pending**

PETRO-CHEM DEVELOPMENT CO., INC
120 East 41st Street, New York 17, N. Y.

Representatives:
Bethlehem Supply, Tulsa and Houston • Flagg Brackett & Durgin, Boston • D. D. Foster, Pittsburgh • Faville-Levally, Chicago • Lester Oberholz, Calif.

MERCOID
MERCURY SWITCHES

Superior Quality and Workmanship

They are not affected by dust, dirt or corrosion and have many definite applications where open contacts are not suitable. Various types available. MERCOID is your guarantee of the best in mercury switches. Further information sent upon request.

MERCOID

catalog upon request.

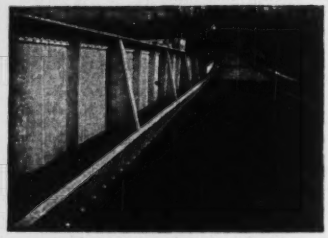
THE ONLY 100% MERCURY SWITCH EQUIPPED CONTROLS

Designed to automatically regulate electrically operated equipment in accordance with changes in temperature, pressure, vacuum, or fluid level.

If you have a problem on the automatic control of pressure, temperature, liquid level, mechanical operations, etc., it will pay you to consult Mercoid's engineering staff — always at your service.

THE MERCOID CORPORATION
4227 West Belmont Avenue, Chicago 41, Illinois
MANUFACTURERS OF AUTOMATIC CONTROLS FOR HEATING, AIR CONDITIONING, REFRIGERATION AND NUMEROUS INDUSTRIAL APPLICATIONS. ALSO MERCOID BRAND MERCURY SWITCHES.

To Save Even One Life-
Who'd Count The Cost?
YOU CAN DO BOTH WITH
IRVING DECKING
The Safest as well as the most Economical
BRIDGE FLOORING
To learn How and Why write for catalog



IRVING DECKING on Rural Fixed Span

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902
Home Office and Plant: 5810 27th Street
LONG ISLAND CITY 1, NEW YORK
Western Division: Foot of Park Ave.
EMERYVILLE 8, CALIFORNIA

• Keep Informed

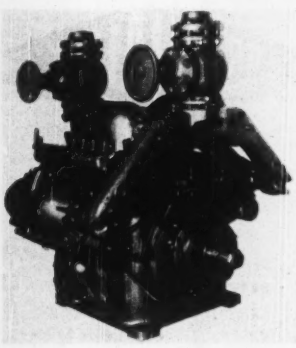
Working pressures of 1000 p.s.i. have been set up as a base standard, although this is merely an arbitrary figure. Actually, units have been designed for pressure well in excess of that figure. All designs are engineered to give a safety factor as required by the service. This extremely high pressure unit for motion control meets the demands of the unusual and exacting conditions of operation in power and process fields, jet engine development, rocket propulsion and atomic development.

Flexoniflex units for absorbing radial and offset motion, as well as axial motion, are engineered from this basic design.

The maximum motion depends upon pressures involved for the specific applications and the frequency of that motion. While it is impossible to give specific data here for all the conditions which can be met, experience indicates that Flexoniflex units can be designed to meet high pressure piping conditions now projected for practical use. CMH engineers are prepared to make specific recommendations upon receipt of prescribed data on the motion control problem.

New Line of Compressors for Ammonia Application Announced by York Corp.

An exclusive and revolutionary new line of high speed refrigeration compressors for ammonia application has been developed by York Corp. for the 1950 market to handle from 15 to 275 horsepower equivalent of refrigeration with a much improved economy, according to John R. Hertzler, Vice-President and General Sales Manager of York Corp.



"Termed V/W compressors because of the arrangement of its cylinders," Mr. Hertzler said, "the new line results in a greater freedom from vibration similar to the finest of airplane engine designs.

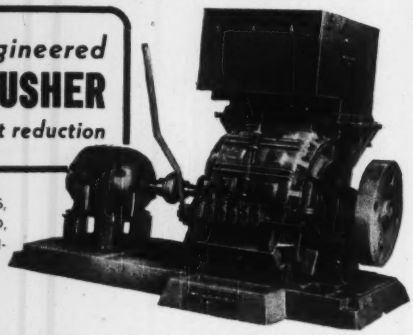
"The compressors have almost indefinite life, because cylinder liners and all other parts subjected to wear can be readily removed for replacement with a minimum of effort and at very low cost. Most of the parts on the various size compressors are interchangeable, thus eliminating the necessity of keeping a large assortment of spare parts in inventory, where a number of compressors have been installed.

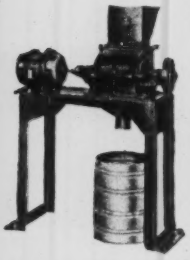
"Upper floor mounting without special foundations is made possible by complete static and dynamic balance of the compressors.

"Because of the compact design, less floor space and head room is required. Quiet performance is made possible by precision-built ring plate type suction and discharge valves, spacious gas ports and gas passages. Start-

There's a job-engineered
AMERICAN CRUSHER
for uniform . . . low-cost reduction

of COAL, CLAYS, CHEMICALS, STONE, METAL TURNINGS, WOOD, DRY ICE, FOOD—hundreds of products of every description.





Laboratory Mill—for testing, pilot plant operation and waste reduction.

Metal Turnings Crusher—reduces long, curly turnings of steel, alloys, brass, aluminum, etc., to uniform chips for highest cutting oil recovery . . . increased scrap value.

"AC" Ring Mill—with exclusive shredder rings—for uniform, high tonnage reduction. 500 TPH. "24 Series" ring or hammer crushers offer capacities to 50 TPH. . . . "30 Series" Hammermills to 100 TPH.

Write for complete information on the famous American line of crushers.

American **PULVERIZER COMPANY**
Originators and Manufacturers of Ring Crushers and Pulverizers
1541 MACKLIND AVE.
ST. LOUIS 10, MO.

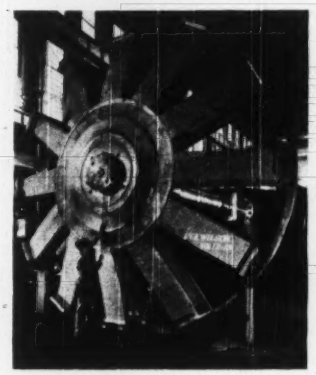
• Keep Informed

ing power requirements are reduced by automatic unloading of cylinders with 'easy start' control.

"Efficient operation at all loads is achieved by capacity reducers that save power costs under varying load conditions. Then too, increased valve life is obtained by anchoring valves to prevent wear by rotation.

"The ammonia V/W compressors are available for use with remote condensing equipment (either water cooled or evaporator cooled condensers) to meet every refrigeration need in the range of 15 to 275 horsepower inclusive. They are designed with four, six, eight, twelve and sixteen cylinders and for direct connection to motor."

Rotor Spider Fitted to Shaft



Fitted on its shaft in the Allis-Chalmers shops is this rotor spider for a 25,200-kw, 28,000-kva, 13,800-volt, three-phase, 60-cycle, 100-rpm vertical hydro-electric generator for TVA's Wilson Dam—the eighteenth and final hydro-electric unit for this installation. The generator is one of ten to be directly connected to Francis runner hydraulic turbines each rated 35,000 hp at 100 rpm under 92-ft head.

New Onsrud Air Turbine Motor with Automatic Governor Gives Constant Speed Under Load

A new air turbine motor has been introduced by the Onsrud Machine Works, Inc. . . . . with the unique feature of automatic governor control. First application for this new motor is in the Onsrud D1-G Air Turbine Grinder . . . a ½ HP, 50,000 RPM unit.

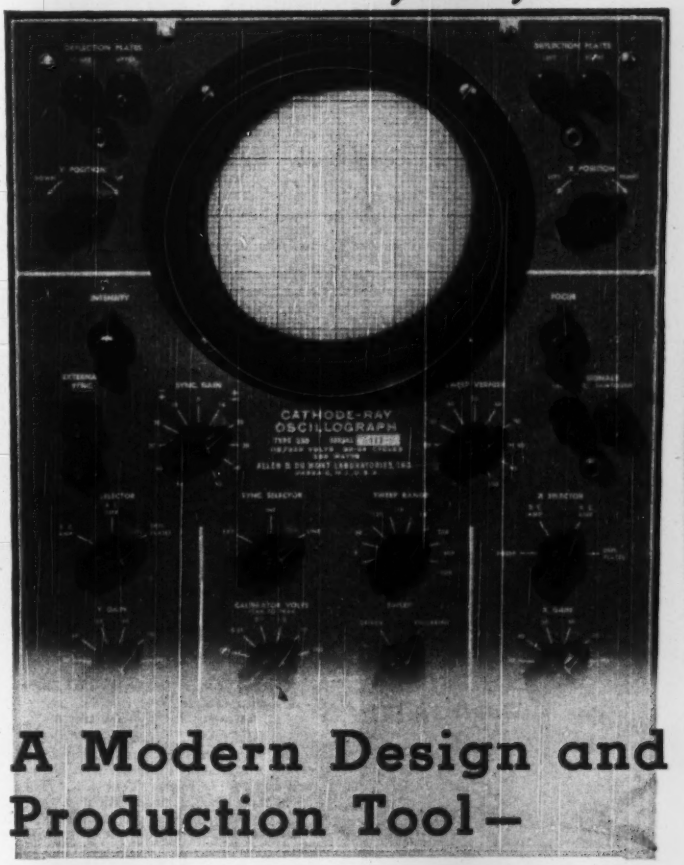
In operation, as the grinder is held against the work, and a resistance is built up that begins to reduce RPM, the Automatic Governor cuts in a greater air volume to maintain rotational speed.

This improvement in Air Turbine Motor design is of considerable importance since it increases the speed of work as well as prolonging grinding wheel life. This result, translated into dollars saved, pays for the original cost of the grinder in a very short period of time.

The Automatic Governor is actuated by centrifugal force, developed by the rotation of

Continued on Page 44

Worth Investigating . . .



A Modern Design and Production Tool—

Its easy-to-interpret-pattern instantaneously provides a graphic, 2 dimensional description of studied phenomena—yet the cathode-ray oscillograph is as simple to operate as your radio. Learn how its versatility was applied to specific mechanical problems presented to Du Mont engineers. Write for pamphlet DT101.

DUMONT *for Oscillography*

ALLEN B. DU MONT LABORATORIES, INC. PASSAIC, N. J.
CABLE ADDRESS: ALBEEDU NEW YORK, N. Y. U. S. A.

Instrument Division, 1000 Main Ave., Clifton, N. J.

the grinder spindle. The motor is designed to operate at 50,000 RPM and as long as this rotational speed is maintained, the governor is not actuated. As the RPM decreases due to work load, the governor becomes operative. When the work load is removed, the effect of greater air supply under governor control will be to speed up rotation beyond 50,000 RPM. When this happens the governor is again actuated, and reduces air supply to normal. By this means, relatively constant speed within close limits is maintained for spindle rotation.

Air turbine motor design with Automatic Governor can be applied to all Onsrud Air Turbine Motor design. Those interested in the present application . . . the D1-G Grinder . . . are invited to write for Bulletin 1000.

Manufacturers interested in Onsrud Air Turbine motors for application to their own equipment or machines are invited to write for complete information. Write Onsrud Machine Works, Inc., 3917 Palmer St., Chicago 47, Ill.

X-Ray Microscope

An X-ray microscope, which makes visible internal details of materials through which light cannot pass, has been developed by scientists of the General Electric Co.

The new instrument was described by Miss Charlys M. Lucht, of the G-E Research Laboratory, at the recent Philadelphia meeting of the American Society for X-ray and Electron Diffraction.

Miss Lucht said that future refinements of the X-ray microscope, at present in the laboratory stage of development, may result in much sharper images and higher magnifications than are possible using visible light.

"The instrument may compete with electron microscopes in the future," she said. Electron microscopes are the most powerful magnifying instruments in use at the present time. They use a beam of electrons rather than light to form an image of materials under study, it was explained.

The X-ray microscope does not require that samples under study be in a high vacuum, as does the electron microscope. Because of this advantage, "it may be possible to examine living materials at much higher magnifications than ever before," according to Miss Lucht.

Clear, sharp X-ray images, magnified ten times, have been produced in the laboratory, and these images have been magnified ten times further by photographic enlargement without serious loss of detail. Thus, at the present stage of development, magnifications of 100 diameters have been produced.

Objects studied to date have been fine mesh screens. Purpose of the studies has been to test the instrument's ability to reveal small details. Miss Lucht reports the results as excellent.

The microscope operates on the principle that X-rays can be reflected from polished surfaces, as can visible light, provided that they strike the surfaces at very small angles, almost parallel to the surfaces. It consists of an X-ray tube and a pair of curved mirrors, which the X-rays strike at an angle of less than one-half degree, after having passed through the sample. The mirrors acting in a manner like that of a convex lens with a light beam, bend the rays in such a manner as to form a magnified X-ray image of the sample on a photographic film.

The mirrors are platinum-coated slabs of fused quartz, which are as nearly flat as surfaces can be made. They are curved by mechanical pressure, which can be adjusted by hand. This arrangement makes it possible to change the mirrors' curvatures in order to improve focusing, Miss Lucht, explained.

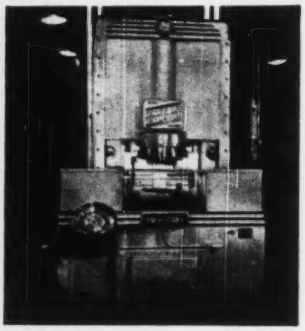
The optical system, sample holder, and dials for making focusing adjustments are mounted in a compact metal unit half as large as a shoebox. The unit is placed a few inches away from the X-ray tube, with the X-ray beam passing through the sample in its holder, thence to the mirrors, and finally to a photographic film located a foot or more away from the unit.

The unit and photographic film are mounted on a long wooden track, which runs parallel to the X-ray beam. The arrangement, which is purely experimental, enables Miss Lucht and her associates to move the optical system and the photographic film relative to each other, and relative to the X-ray source.

Shear-Speeds for Internal Gears and Other Internal Forms Announced by Michigan

Availability of "Shear-Speed" machines for cutting of internal spur gears, splines and other miscellaneous forms has been announced by Michigan Tool Co., 7171 E. McNichols Road, Detroit, Mich.

Almost any irregular shape can be cut providing it lends itself to form-cutting with radially fed tools. Minimum size (ID) which can be handled is 5.4 in. Maximum ID which can be cut is approximately 20 in. In some cases even smaller and larger gears can be cut.



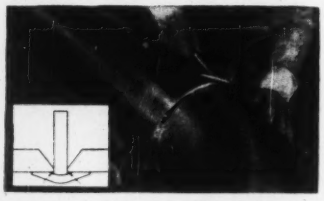
In operation, the "internal gear" Shear-Speed machines simply reverse the tool-feed action of the machines used for cutting of external forms. Using two inverted

Continued on Page 46

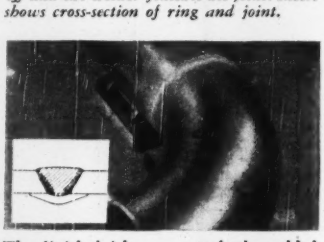
HOW
TO WELD PIPE FASTER AND BETTER

● The *only* completely engineered welding rings—Tube-Turn groove type rings with knock-off spacer pins—are the answer. They permit fast assembly with exact joint spacing and complete weld penetration. They're easy to use . . . save time.

Ring snaps easily into place. Knock-off spacer pins space and center the pipe accurately and automatically.



Tacking completed, spacer pins are knocked off and the welder finishes his joint. Insert shows cross-section of ring and joint.



The finished job . . . a perfectly welded joint. Irregular black area (see insert) indicates greater width of fusion zone obtained with Tube-Turn welding ring.

FREE BOOKLET

Write today for free booklet "Tube-Turn Groove Type Welding Rings." Gives detailed, illustrated instructions on use . . . complete dimensions, weights, and prices.

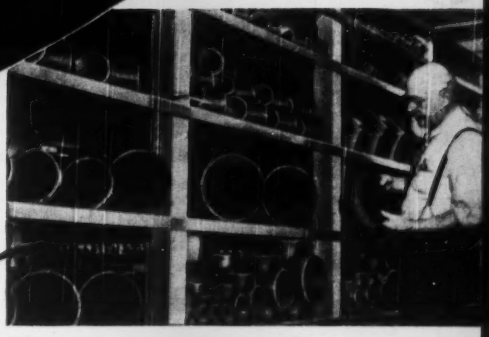
"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

In all the world there's only one "TUBE-TURN" Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

TUBE-TURN

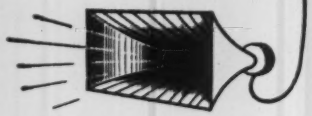


Your local distributor has a big stock. Get him on the phone!

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

facts speak LOUDEST



At least one type of Molybdenum high speed steel is listed and promoted on a basis of equivalent and interchangeable performance with tungsten steel, by makers of high speed steel.

Users' reports of Molybdenum high speed tools *everywhere* indicate that performance at least equals and in many cases betters that of tungsten tools.

The heat treatment of Molybdenum high speed steels is basically the same as that of tungsten steels. There is nothing in the treatment to confound those who are familiar with the heat treatment of tungsten types.

Molybdenum high speed steels save money in production—for proof send for our FREE booklet.

Climax Molybdenum Company
500 Fifth Avenue • New York City

MAIL THIS COUPON

Please send me a copy of your FREE BOOKLET

Name .....

Co MOLY

Address .....

MB3-HS2

• Keep Informed

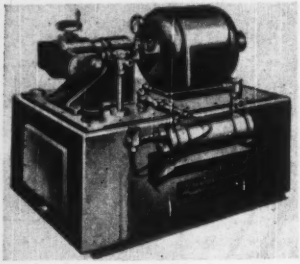
cones, the tools are fed outward before each stroke of the reciprocating work and its holder. They are retracted slightly before the return stroke to prevent tool drag. Feed is decreased to finish-feed as proper depth of cut is approached. Two or three strokes at exact depth (without feed) are generally used to "clean up" before the head retracts and the machine stops for reloading.

The first of the internal gear machines put into service has already cut 5000 gears of 12" pitch diameter without requiring a tool grind. Machine cycle time on this job was 24 secs for an hourly production of 85-90 parts.

When necessary, tools are reground as on other types of Shear-Speed machines by locking the individual form tools together on the magnetic chuck of a surface grinder and merely removing a few thousandths (.010–.015 in.) from the top face of the tools, simultaneously. No other grinding is necessary.

Denison Introduces New Line of High Pressure Oil-Hydraulic Pumping Units

To meet a wide range of fluid power requirements for machine tools and other industrial equipment, The Denison Engineering Co., 1171 Dublin Road, Columbus 16, Ohio, has announced a completely new series of oil-hydraulic pumping units for regulative pressures up to 5000 psi. These high pressure units are available in 22 models designed to specifications recommended by the Joint Industry Conference, Hydraulic Standards for Industrial Equipment.

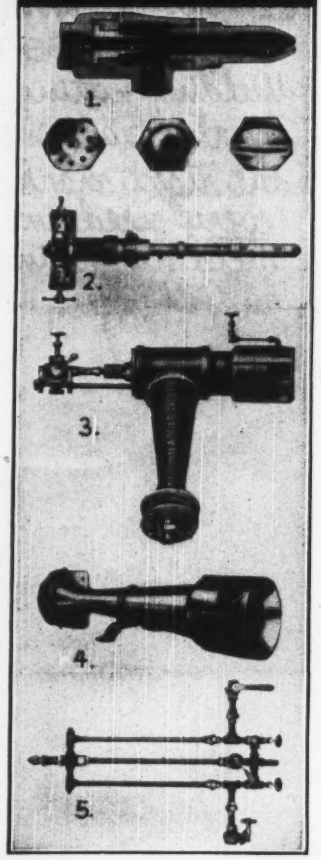


Each unit consists of a reservoir base, with all operating components, including pump, relief valve, gauges, and electric motor drive, mounted on the removable top cover. The simple compactness throughout is said to be an important advantage in obtaining sufficient power for many types of modern machinery, without penalty of excessive bulk.

The reservoir of these high pressure pumping units is supplied in capacities of 55, 110, and 165 gallons. It is of welded steel construction and has an access door at the end to simplify tank cleaning. Bottom of the reservoir is above floor level, and it slopes slightly to facilitate draining.

A choice of three series of Denison hydraulic pumps is offered. These are of axial piston type and may be for either constant or variable volume. The 600 series pumps deliver up to 9 gpm at 1800 rpm in a pressure range up to 5000 psi. Pumps of the 700 series are rated at 20 gpm at 1200 rpm for requirements up to 5000 psi. The 800 series provide a maximum 35 gpm at 1200 rpm for serivce up to 5000 psi. The variable volume pumps are available with a choice of handwheel pressure compensating stem or cylinder control of oil delivery. The constant displacement pumps are basically of the same design and construction, exclusive of the controls. In addition to compactness, other out-

THE *RIGHT* OIL BURNER OR GAS BURNER *FOR YOUR JOB*



TYPE "S-A"

1. (For use where steam is available) *atomizes thoroughly* and *burns completely*, the lowest and cheapest grades of fuel oil and tar, requiring only low oil pressure and temperatures. Send for Bulletin #21.

TYPE "S-A-L"

2. (Large capacity burner similar to TYPE "S-A-R") is adaptable in combination with powdered coal burners in large boilers. Send for Bulletin #24.

COMBINATION GAS AND OIL BURNER

3. —the "AIROCOOL" Gas Burner in combination with a TYPE "S-A-R" Oil Burner. Send for "AIROCOOL" Brochure.

"AIROCOOL" GAS BURNER

4. (Of venturi type) assures low turndown without burnback. Send for "AIROCOOL" Brochure.

TYPE "S-A-D"

5. (Refuse Oil Burner) burns acids or caustic oils, sludges, asphalts, tank bottoms, polymer oils, heavy petrolatum, organic oil residuums, waste cutting oils, sulphite pulp liquors, etc. Send for Bulletin #21.

NATIONAL AIROIL BURNER CO., INC.

Main Offices and Factory:
1239 E. SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard
Houston 6, Texas

• Keep Informed

standing features of dependability and quiet operation are reported to suit these pumps especially for industrial installations.

The pump and electric motor are mounted horizontally on the reservoir cover plate and connected by a flexible coupling. Motors supplied with this equipment range from 5 to 75 horsepower ratings according to requirements of service.

Accurate adjustment of pressure within desired ranges up to 5000 psi can be made with the relief valve, which is the Denison threaded body type. A knurled adjustment knob is provided on the valve cap. Pressure gauge and gauge shut-off valve are connected directly to the relief valve and used for initial setting of system pressures.

The manufacturer states that optional equipment is available to further extend the versatility of these high pressure oil-hydraulic pumping units. For example, a heat exchanger attachment can be provided for cooling oil in the hydraulic system, and a vacuum gauge added to permit easily checking condition of the oil filter within the reservoir at any time.

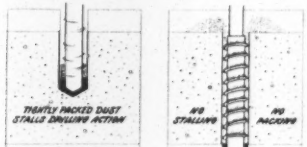
The oil cooler consists of a standard 2-pass heat exchanger, complete with thermostatic control that automatically starts and stops coolant flow at desired temperatures. Water is used as the coolant. Temperature at which the oil cooler becomes operative is adjustable. The oil cooler is recommended for installations where the pumping unit is operated at 50 per cent or more of maximum pressure, or for 10 per cent or more of the total cycle time. A bypass circuit and low pressure relief valve protect the heat exchanger from sudden surges of pressure or flow. A dial indicator temperature gauge is also available to indicate temperature of oil within the reservoir.

As conditions vary with each unit installation, it is difficult to establish how often the oil filter should be cleaned. The optional vacuum gauge simplifies timing this important maintenance function. With the vacuum gauge, the need for oil filter cleaning is plainly indicated. When the gauge shows a reading of 10 in. mercury at 100 degrees F., the filter is dirty or clogged and should be cleaned. Unless a definite maintenance program is followed, use of the vacuum gauge is recommended.

Unique Idea in Masonry Drill Design May Revolutionize Drilling of Hard Materials

The unique idea of applying high tensile wire to form a "live-spiral" flute on the shank of a carbide masonry drill promises to alter, simplify and reduce time and cost in the drilling of holes in masonry, brick, tile, concrete and similar materials.

Announced by the Carboloy Co., Inc., Box 237—Roosevelt Park Station, Detroit 32, Mich., the new drill development is claimed to represent the greatest single advance ever seen in carbide tipped masonry drills.

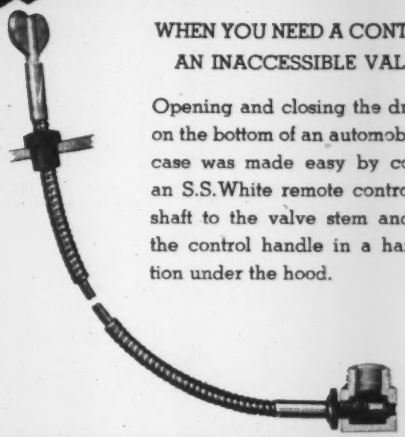


Not only does the new drill cut faster, but it keeps right on going deeper with greater ease than with conventional types of drills. There is no necessity for withdrawing the drill to remove dust from the hole because

Continued on Page 48

S.S. White

FLEXIBLE SHAFTS SIMPLIFY DESIGN



WHEN YOU NEED A CONTROL FOR AN INACCESSIBLE VALVE . . .

Opening and closing the drain valve on the bottom of an automobile crankcase was made easy by connecting an S.S.White remote control flexible shaft to the valve stem and placing the control handle in a handy location under the hood.

THE above example is typical of the way in which S.S.White flexible shafts simplify and improve designs. In this case, a seemingly complicated problem was solved by a single, self-contained flexible shaft—no gears, pulleys, universal points or other mechanical elements were needed. Can you think of an easier way to provide an inaccessible part with a conveniently operated control?

For further case histories and more flexible shaft details,

WRITE FOR BULLETIN 4501

S.S.White MAKES IT RIGHT

It contains essential facts and data on flexible shaft selection and application. A copy is yours on request.

S.S.WHITE INDUSTRIAL DIVISION

THE S. S. WHITE DENTAL MFG. CO. — DEPT. L, 10 EAST 40th ST., NEW YORK 16, N. Y.

FLEXIBLE SHAFTS AND ACCESSORIES
MOLDED PLASTICS PRODUCTS—MOLDED RESISTORS

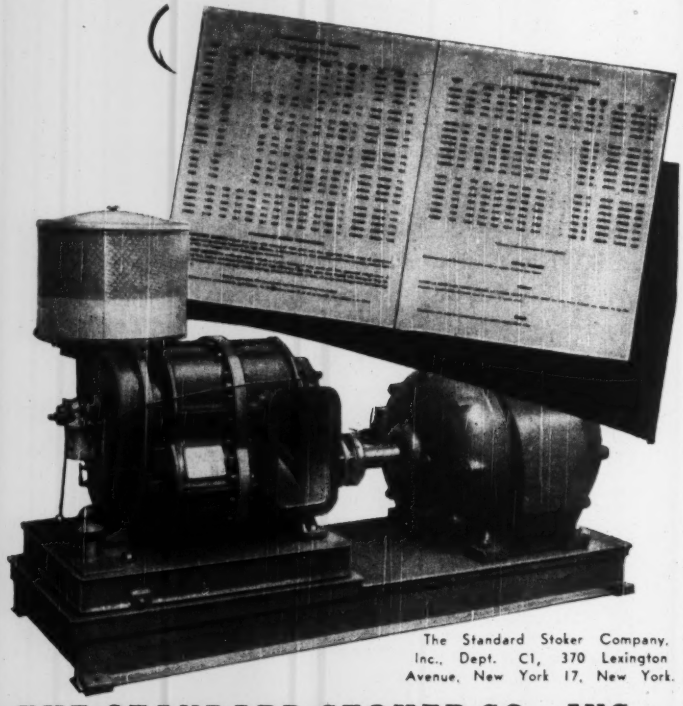
One of America's AAAA Industrial Enterprises

The STANDARDAIRE
PRECISION BUILT
Axial Flow BLOWER

To meet specific and variable pressures, Standardaire Positive Displacement Blowers are built in a series of sizes to fulfill a wide range of capacity requirements from directly connected, standard speed motors—the modern method of producing just the amount of air required at the minimum cost. Direct-drive motor speeds also provide for an even air flow resulting in smaller pulsations that are easy to dampen out and do not create shock loads in the blower or delivery system. If the type of service demands other than direct drive, a pulley attachment can be readily applied to the blower for particular specifications.

The flexibility of speed and pressure possible with the Standardaire Blower eliminates a great number of blower types normally required in the positive displacement field—a desirable engineering advancement in blower design without disturbing fundamental principles.

For full information and a complete list of blower sizes, write for Standardaire Selection Chart, Publication No. 86.



The Standard Stoker Company, Inc., Dept. C1, 370 Lexington Avenue, New York 17, New York.

THE STANDARD STOKER CO • INC •

Standard Stoker 555

NEW YORK • CHICAGO • ERIE • MONTREAL

• Keep Informed

the "live-spiral" flute cleans the hole while the hole is being drilled.

While carbide drills long ago demonstrated their ability to cut holes cleaner and faster than conventional types, the drills were open to the same objections as were steel drills (left illus.). Dust accumulated in the bottom of the hole and gradually packed almost solid. Gradually the 'bite' of the drill would decrease until a point was reached where even heavily increased pressure on the drill would not result in further cutting but would only cause the drill to slow down—or even stall—due to the excessive load on the drill motor. At this point—usually equal to about 3 times the diameter of the drill—it would be necessary to withdraw the drill, clean out the hole, and start drilling again. This operation usually had to be repeated several times if the hole were of any depth.

With the new Carboloy wire "live-spiral" masonry drill, the wire, solidly attached to the shank at lower and upper end, is wound around the shank in a low-spiral helix.

The striking effect of this unique idea has to be experienced or seen to be appreciated. Dust cut loose by the tip in any type of masonry "marches" right up around the spiral and out of the top of the hole (right illus.) accumulating in a neat circular mound around the O.D. of the hole. Pressure required on the drill is no greater at the end of a deep hole than at the start.

Since the dust is removed as fast as it is formed, there seems to be no tendency for the dust to pack in the hole. "Dust explosions" are also eliminated. Less heat is generated. Drill life is increased. A nearly constant rate of penetration results.

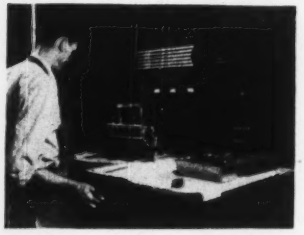
The new drills—which fit any rotary drill, drill press or hand brace—list at the same prices as former round shank drills and are available in ten diameter sizes ranging from $^1/_4$" up to and including 1".

Each drill is individually packaged in a transparent plastic tube with a screw top. Drills are offered also in three kits, two of these containing six drills each (from $^3/_{16}$" to $^5/_8$" and from $^1/_4$" to $^3/_4$", respectively). A third kit contains the popular $^1/_4$", $^3/_8$" and $^1/_2$" sizes.

G-E Induction Heater Cuts Production Costs for Pennsylvania Company

A General Electric electronic induction heater used by the Hunter Spring Co. of Lansdale, Pa., to braze beater-blade assemblies for portable mixers has reduced the firm's production costs, improved the product, and practically eliminated rejects.

Rated 20 KW output at 530 kc, the heater was installed in October of 1947. It permitted the replacement of a riveted beater assembly with a stronger brazed beater assembly.



P. C. Clarke, Assistant General Manager of the Hunter Company, said that the electronic induction heater "reduced our pro-

• Keep Informed

duction costs by one cent per unit or about $36 a day. One of the features we like best about the G-E heater is the diversity of the work which can be performed on it," he said.

In the induction brazing operation six beater-blade subassemblies are inserted into a jig. Flux and a small square of silver brazing alloy are placed on each sub-assembly where the four points of the blade come together. Next, the beater stem is placed over this point and locked into position. When the jig indexes the beater assemblies into the work coil of the heater the blade-stem joints are brazed first, after which the heater automatically brazes the batter guards to each stem. At the end of the heating cycles, the six completed assemblies are removed from the jig and passed on for further finishing.

The heating cycle for the brazing operation on six beaters at a time is 11 seconds for the blade-stem joints, a quarter-second delay, and 12 seconds for brazing the batter guards to the stems.

An average of 1800 beater blades are brazed per eight-hour shift, or 225 per hour. With a 16-hour day, total production for a five-and-a-half-day week is 20,000 beater blades.

The Hunter Spring Co. manufactures various types and sizes of coil springs, metal stampings, wire forms, and mechanical and electrical assemblies. Sometimes when the G-E electronic induction heater is not being used to braze beater-blade assemblies, it performs special annealing and brazing operations on springs and stampings. Many of these operations are on work which the company previously had to turn down

Engineering officials of the Hunter Company stated that the completely brazed beater-blade assembly is superior to the previous riveted assembly because: 1) the number of component parts has been reduced from six to four, 2) the brazed joints, by proven tests, are stronger than riveted ones, 3) the batter guard cannot work loose and fall on the blades as it did sometimes with the riveted assembly, and 4) the unit is easier to clean because there are no crevices where food can collect and the center rod is eliminated.

The engineers added that the number of rejects was substantially reduced because on the riveted assemblies the plating solution would sometimes bleed out of the crevices and corrode the blades, thus causing rejection during final inspection. This was completely eliminated with a brazed assembly.

Drive Pin Rivets

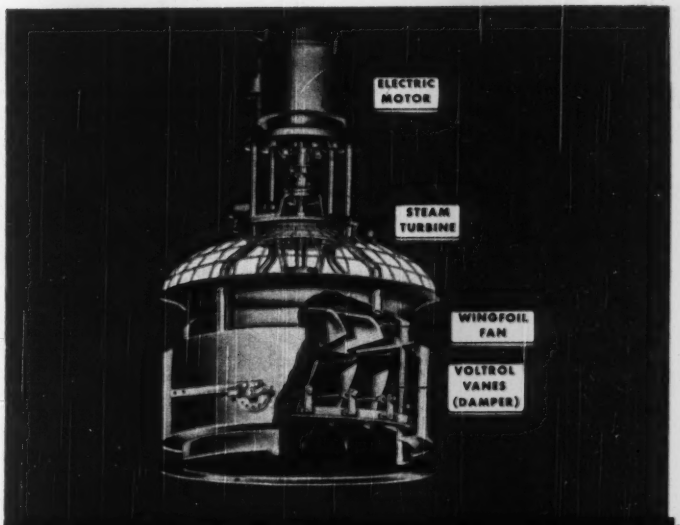
A hammer driven rivet, the Drive Pin Blind Rivet series, has now been added to the Cherry Rivet Company's standard line of mechanical blind rivets.

These rivets may be installed by using an ordinary hammer. Excellent joints are made with the Drive Pin Rivet in a fraction of the time required for self-tapping screws, solid rivets or nuts and bolts, according to the manufacturer.

A Drive Pin Rivet is an assembly of two parts; a hollow rivet member with the hole tapered toward the bottom, and a serrated drive pin assembled part way into the hole in the rivet. The end of the rivet shank is slit longitudinally by two right angle cuts.

These rivets are installed with a hammer. A hammer blow causes the pin to contact the tapered section of the hole. The surrounding section of the rivet shank is first expanded into the hole in the material and then the four sections at the free end are expanded to form a blind head at the back side of the

Continued on Page 51



New Wing Forced Draft Blower Incorporates both turbine and electric drive in one unit

With the new Wing Dual Drive Forced Draft Blower you can alternate between turbine and electric drive. Your choice of drive may be governed by consideration of heat balance, of economical operating cost, or by an emergency affecting the source of power. All you have to do is throw a switch to operate the motor or turn a couple of valves to change to turbine drive! There is no harm to either motor or turbine when one or the other is idle. A wide range of control is possible in both motor or turbine drive. Throttling gives adequate control with turbine drive and the Wing Voltrol Vanes (capacity regulating dampers) permit capacity regulation when constant speed motor is driving. Automatic operation may be arranged with combustion-control system. The unit is extremely compact and may be adapted to either vertical or horizontal discharge. Installation is simple, easy and economical. It is shipped completely assembled and aligned, ready to bolt to the foundation.

Write today for further details

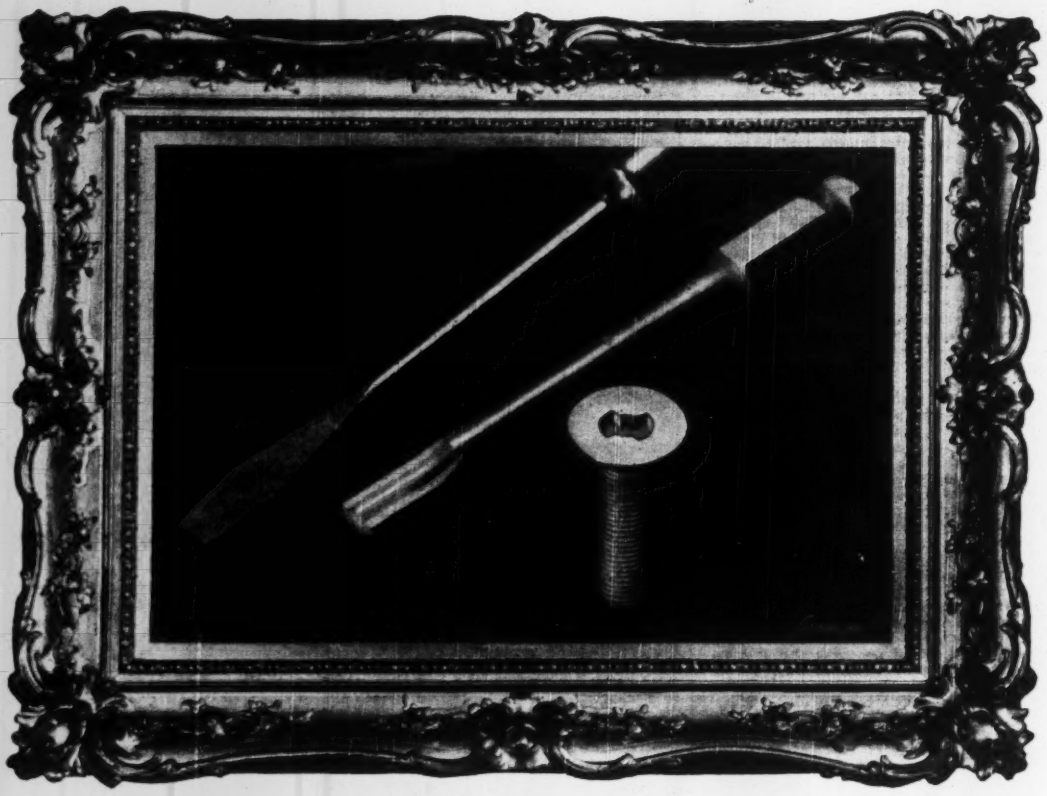
L. J. Wing Mfg. Co.

Executive Offices and Factory: 156 Vreeland Mills Road, LINDEN, N. J.

Canadian Factory: Montreal, Canada

WING

Wing DUAL-DRIVE BLOWERS



Acclaimed a Masterpiece...

CLUTCH HEAD *Brightens the Profit Picture with 15% to 50% Assembly Increases*

Here is how CLUTCH HEAD'S modern design meets today's competitive selling problem of "*How to Produce More for Less*"... by effecting time and cost savings that quicken production steps all the way down the assembly line.

High Visibility of the roomy recess presents an easy-to-hit target. "Green" operators require no break-in. They drive with speed and confidence that checks out slow-down hesitation.

Chewed-up Heads Eliminated because dead-center entry with the Center Pivot Column prevents driver canting and makes straight driving automatic.

Safe Non-tapered Driving eliminates the danger of driver skidding from "ride-out" as set up by tapered driving . . . an important safety factor for the protection of manpower and material.

Zero in Skid Damage is reported by CLUTCH HEAD users. The all-square contact of the straight-sided driver with the straight-walled recess makes high torque driving almost effortless.

A Fatigue Factor Disposed Of. Absence of end pressure means safer, faster, easier driving. No end-of-the-shift lag means more screws driven for higher production.

Up to 214,000 Screws Driven non-stop by the Type "A" Bit . . . without interruption for tool change or reconditioning. Add to this record performance the fact that a 60-second on-the-spot operation restores this bit to original efficiency . . . *repeatedly*.

The Lock-On Overcomes Fumble Spots. A reverse turn of the bit in the recess forms a frictional hold that unites screw and bit as a unit. This permits quick, easy one-handed reaching to inner spots.

Speeds Field Service Too. With the Type "A" Hand Driver, field service men find it easy to withdraw "frozen" screws undamaged and safely held by the Lock-On on the end of the bit for re-use.

Common Screwdriver Operation. This is the *ONLY* modern screw with a recess basically designed for operation with a flat blade . . . which need only be reasonably accurate in width. Important to simplified field service.

CLUTCH HEAD SCREWS

These highlights of America's Most Modern Screw are fully detailed and illustrated in the NEW CLUTCH HEAD BROCHURE. ***Send for your copy and indicate the sizes and types of screws that interest you.***

UNITED SCREW AND BOLT CORPORATION

CLEVELAND 2 CHICAGO 8 NEW YORK 7

material. The action of driving the pin into the rivet forces the rivet against the top sheet of the materials being fastened. This action in turn forces the top sheet tight against the back sheet. The blind head formed at the back of the work makes a permanent joint. The resulting joint is tight and has high resistance against loosening in service.

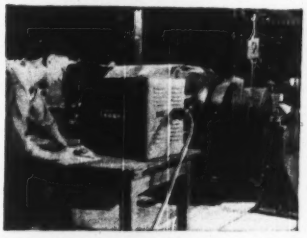
Advantages of the Drive Pin Rivet include the convenience of working from one side of job, a simplicity of installation that precludes instruction or the need for skilled labor, broad material thickness tolerance,as well as the elimination of special tools.

The Cherry Drive Pin Rivet supplements the standard line of Cherry Rivets. Generally speaking, the Drive Pin Blind Rivet has the necessary shear and tensile strength to meet average requirements, and will perform well where relatively thin metal sheets are fastened to heavier sections and where heavier gauge sheets are fastened to one another. Other types of Cherry Rivets meet more exacting requirements where (1) the fastener is highly stressed in shear (2) considerable vibration is encountered (3) sheets to be fastened are light gauge and (4) tension loads are abnormal.

G. E.Announces New Precision Tachometer for High Speed Measurement

A new electronic "pulse counter" for accurate measurement of very high speeds has been announced by General Electric's Special Products Division. Designed for special applications which call for precison measurement over a wide range of rotating speeds, the new tachometer was developed by the company's General Engineering and Consulting Laboratory and Lynn (Mass.) Turbine Engineering Division.

The equipment consists of a high-frequency pulse generator or pick-up, an electronic counting circuit, and two speed indicating units: one for "on the spot" readings and the other for remote readings.



Now being used in testing the efficiency of steam turbines at the G-E Lynn River Works, the first of the pulse counters measures speeds in the range of 0-17,000 rpm. In this application a magnetic pulse generator fits on the periphery of a drum which is attached to the shaft of the machine to be tested. The drum is magnetized, one side containing 150 magnetic poles and the other side 1500. When rotated, the drum generates electrical impulses in the magnetic pick-up which are carried to the electronic circuit, and there counted at speeds up to 50,000 cycles per second. The indicators do the necessary calculation and interpolation, and flash on an opal glass screen, in figures approximately 1-in. high, the number of revolutions per minute. Continuous readings are made and the figures on the screen change every second to indicate any variations in the rpm.

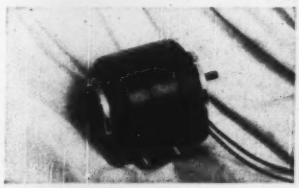
Up to 4000 rpm the 1500-pole side of the generator is used, with an accuracy to 0.1 rpm, while over 4000 rpm the magnetic pick-up automatically shifts to the 150-pole side and the readings are accurate to 1 rpm. G-E engineers said that any system which generates electrical impulses can be used in place of the magnetic pick-up. For example, they said, a disk on the shaft of the machine to be tested could be marked with black and white stripes and a photoelectric pick-up used to gather and relay the pulses to the electronic circuit.

A reading is taken every second. The counting operation requires $^{8}/_{10}$ sec, while the calculation, interpolation, and indication of the figures utilize the remaining $^{2}/_{10}$ sec of the cycle. The timing for this fractional split is governed by a 1,000 beat tuning fork oscillator which is accurate to about .001 per cent.

The electronic counting circuit is housed in a 200-lb. cabinet which measures about 5 × 2 × $1^{1}/_{2}$ ft. The speed indicator is housed in a separate cabinet, approximately 2 × 2 × $1^{1}/_{2}$ ft. The electromagnetic tachometer generator weighs about 5 lb and is approximately 6 × 8 × 4 in. Two hundred ft of cable may be used between the tachometer generator and the control cabinet, and another two hundred ft of cable may be used between the control cabinet and the indicating units.

New Line of Lifetime-Lubricated, Unit-Bearing Motors for All-Angle Operation Announced by General Electric

A new line of lifetime oil-lubricated, shaded-pole motors designed for operation in any position—shaft up, down, horizontal, or at any intermediate angle—has been announced by General Electric's Fractional Horsepower Motor Divisions.



Designated as Type KSP—frame sizes 11 and 21, the new motors can be used as drives for exhaust fans, cooling fans, evaporative coolers, unit heaters, condenser cooling, and space heaters, as well as for small pumps, agitators, and blowers.

The motors are available in either open or totally enclosed construction. Ratings range from 25 millihorsepower ($^{1}/_{40}$ hp) through $^{1}/_{12}$ hp at 115 or 230 volts, 1050 or 1550 rpm, 60 cycles.

A new lubrication system provides a constant flow of oil from a large reservoir to the bearing surfaces regardless of the position of the motor. Oil-saturated packing continuously feeds the bearing with filtered oil; no additional lubricant is ever required.

Other features include a new unit-bearing construction in the shaft end of the motor for greater strength on direct-connected loads; treated stator windings of Formex (R) insulated wire; and vibration-absorbing resilient end rings which are resistant to oil and aging.

Mounting arrangements for the new motors include resilient end ring mounting, resilient cradle base, and band mounting. Motors also are available with four tapped holes on the shaft end for end mounting.

Continued on Page 52

We sure lay it on the line with the MICROTOMIC "VAN DYKE" Hi-Density Lead -'s far as clear sharp prints are concerned !

And MICROTOMIC drawing pencils lay it on the line, too, with a certified UNIFORMITY OF GRADING which delights a Draftsman's soul. For dependability, they're the tops . . . 18 degrees from 9H to 7B.

TRADE MARKS REG. U. S. PAT. OFF.

The EBERHARD FABER Drawing Pencil

ON SALE AT ENGINEERING & BLUEPRINT HOUSES

• Keep Informed . . .

Largest Circular Photographic Plates to Be Used with New Telescope

Seventy dozen of the largest circular photographic plates ever used by astronomers are being rushed to completion by Eastman Kodak research scientists, the company announced recently.

The infra-red and -blue sensitive plates will be used on the "Hub of the Universe" expedition of Harvard University astronomers sailing for South Africa.

A team of Harvard astonomers will use the plates with a new type of telescope and the world's largest objective prism to study more than one million stars and other interstellar bodies in the Milky Way.

The astonomers will use the new telescope to photograph the center portion of the Milky Way, more than 30,000 light years from the earth. Present telescopes have been limited to detailed explorations of stars less than 10,000 light years distant.

The special plates are 10½" in diameter. Largest present circular plates used are 7¾" in diameter. They are used for making photographs with the Burrell telescope of the Warner and Swasey Observatory in Cleveland, Ohio.

The plates are being coated with emulsions especially sensitive to light of different colors and long exposures to faint light. Work is being done by the emulsion research department of Kodak Research Laboratories.

The plates will be packed in heat-sealed foil envelopes as protection against hot and moist tropical climate. A refrigerated compartment will be used for storage on board ship.

Professor Bart J. Bok, associate director of the Harvard College Observatory, will head the team of three Harvard astonomers making the expedition.

New Cloth Ends Need for Negative in Reproducing Engineering Drawings

The conventional negative step used in making cloth reproductions of engineering drawings can be eliminated by the use of Kodagraph Autopositive Cloth, a new photosensitized cloth developed by the Eastman Kodak Co.

Like other "Autopositive" materials, Kodagraph Autopositive Cloth produces a positive copy directly from a positive original drawing. It may be handled in normal room light and is exposed on conventional blueprint or direct-process machines or a vacuum printing frame.

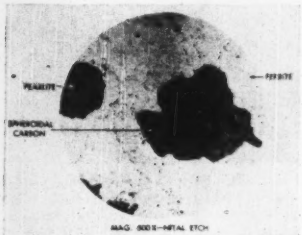
Not only does elimination of the negative result in savings in time and materials, it also produces a cloth reproduction free from the distortion introduced by the use of paper negatives.

The new cloth is highly translucent, assuring rapid production of quality shop prints, and may be drawn in on either side, using ink or pencil. It is available in 30- and 100-foot rolls in the following widths: 20, 30, 36, and 42 inches.

Ductile Cecolloy

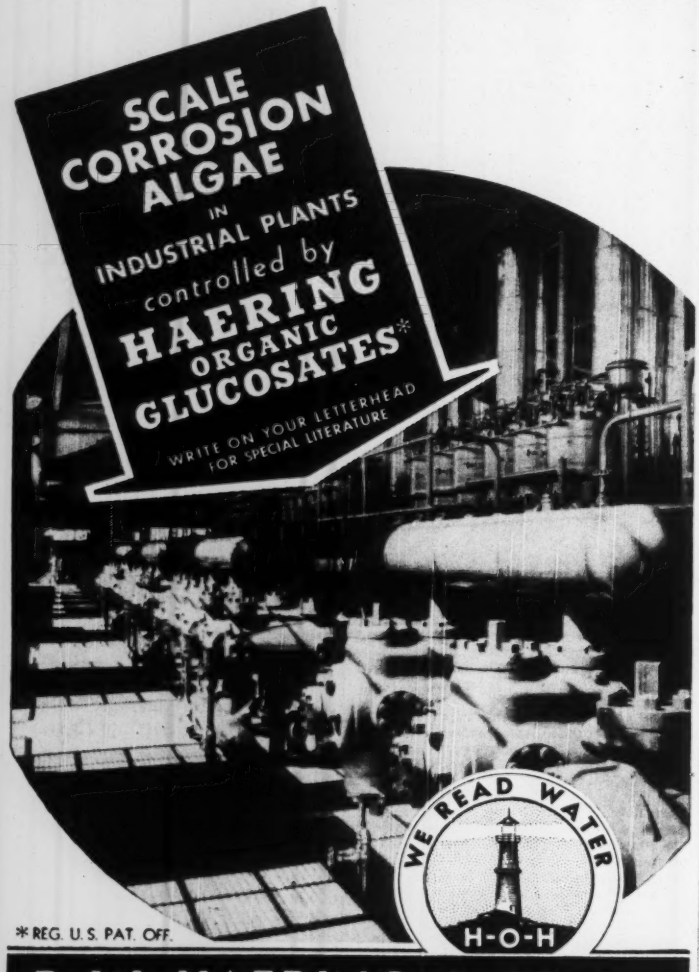
The Chambersburg Engineering Co., Chambersburg, Pa., manufacturers of forging equipment, is now producing large and small castings of Ductile Cecolloy for component parts of many Chambersburg products and is also marketing the material in the heavy jobbing casting field.

After more than four months of development work, they have successfully produced castings weighing up to 40,000 lbs. which possess high tensile strength, a substantial amount of ductility with a high yield strength and high elastic modulus.



Basically the material is a high-carbon cast iron, treated with magnesium to transform the graphite from the normal flake form to spheroidal form, thus retaining self-lubricating properties and much of the vibration-dampening properties of cast iron, while virtually eliminating the inherent weakness of normal cast iron which results from the notch effect of flake graphite. The metallic matrix of the material is essentially steel, which can be produced with appropriate microstructures to give desired physical properties. It is also subject to heat treatment for alteration and improvement of physical properties.

Ductile Cecolloy can be produced to specifications within the ranges of the following physical properties as cast: Tensile Strength 60,000 to 80,000 P.S.I.—Yield Strength



MAKE SURE YOUR EQUIPMENT IS RUNNING RIGHT before you deliver it...

Eliminate VIBRATION and NOISE

Locate trouble IN ONE SECOND

with the AP-1 PANORAMIC SONIC ANALYZER

Ideal for Production Line

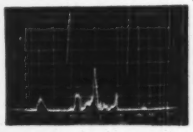
The AP-1 Panoramic Sonic Analyser is portable enough for field or spot work or can be set up permanently in the production line. Visual spectrum scanning screen can be readily compared with standard pattern. Simple to operate—automatically and visually portrays frequency and relative amplitude of noise and vibrational components—eliminates tedious, complicated point-by-point frequency checks.

More and more engineers have discovered the overall advantages of the AP-1 for examining the vibrations associated with rotating equipment, particularly equipment that tends to hunt in speed. Learn what it can do for you.

LOCATE NOISE AND MECHANICAL TROUBLE Easily and Quickly

Analyzes visually at one second intervals Noise and Vibration of rotating equipment—gears, bearings, motors, engines, turbines, blowers, fans, factory machinery, etc.

INDICATED AUTOMATICALLY BY VISUAL SPECTRUM SCANNING



These instruments are backed up by over 15 years' experience in developing and pioneering panoramic spectrum analyzers.

WRITE FOR FURTHER INFORMATION

PANORAMIC RADIO PRODUCTS INC.

10 South Second Ave., MOUNT VERNON, N. Y.

• Keep Informed

40,000 to 60,000 P.S.I.—Elongation 0 to 15% —Modulus of Elasticity 22,000,000 to 25,000,000 P.S.I.

Although higher in cost than cast iron, Ductile Cecolloy is lower in cost than cast steel. Weight reduction made possible by its high strengths will in many cases result in economies over cast iron construction, and further economies will result from its substitution for cast steel where physical properties permit.

Machinability is equal to or better than cast steel and fine finishes are easily attained thus resulting in cost savings and enhancing the wear resistant properties.

• BUSINESS CHANGES

Taylor Forge Canadian Subsidiary

Taylor Forge & Pipe Works, Chicago, has announced the formation of Taylor Forge & Pipe Works of Canada, Ltd. This new subsidiary will be located at Hamilton, Ontario, and will augment the productive capacity of the company which now has plants at Chicago, Illinois, Carnegie, Pennsylvania and Fontana, California. The new facilities at Hamilton will permit the company to participate actively in the Canadian market for the products of its manufacture.

Taylor Forge & Pipe Works was organized in 1900 by J. Hall Taylor who is Board Chairman of the company. The company has pioneered in the manufacture of various important engineering products, notably wrought steel fittings for pipe welding, spiral welded pipe and a wide range of heavy forgings for boilers, pressure vessels and so forth.

Operations at Hamilton will start in a new building now being designed to suit exactly the intended manufacturing. It is hoped that the new facility can be staffed with Canadian personnel.

Rivett Lathe & Grinder, Inc. Acquires Gerotor Valves and Cylinders

Rivett Lathe & Grinder, Inc., Boston, Mass., announces the purchase of the entire line of Gerotor air and hydraulic valves, cylinders and hydraulic power units from Gerotor May Corp., Baltimore, Md. All manufacturing and selling operations of the line are being transferred immediately to Boston with no interruption in acceptance and delivery of orders.

Gerotor May Corp. is retaining the manufacture and sale of Gerotor hydraulic pumps and fluid motors at Baltimore, Maryland.

The new Rivett line will be marketed through the present Gerotor dealer organization, which will likewise continue to handle Gerotor hydraulic pumps and fluid motors. Present plans call for the Gerotor trade name to identify the new Rivett line.

Rivett will offer all models in the line it has acquired, planning to continue design changes to further improve operating efficiency.

John A. Marsh, formerly special sales representative for Gerotor May Corp., is the new Sales Manager for the valve and cylinder division of Rivett Lathe & Grinder, Inc.

Foster Wheeler French Subsidiary

Foster Wheeler Corp., New York, has organized a French subsidiary, Societe Foster Wheeler Francaise, for handling European construction activities, according to H. S. Brown, chairman of the parent corporation. The French company will maintain offices at 6, Rond Point des Champs Elysees in Paris. R. M. Serre will direct the sales work on the Continent of Europe with headquarters at the Paris office.

Continued on Page 54

THOMAS Flexible ALL METAL COUPLINGS

FOR POWER TRANSMISSION REQUIRE NO MAINTENANCE

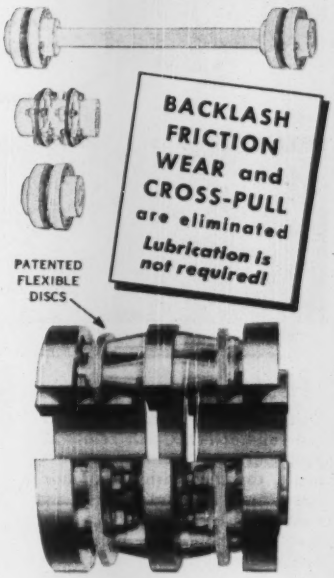
Patented Flexible Disc Rings of special steel transmit the power and provide for misalignment and end float.

Thomas Couplings have a wide range of speeds, horsepower and shaft sizes:

½ to 40,000 HP

1 to 30,000 RPM

Specialists on Couplings for more than 30 years



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT.

NO MAINTENANCE PROBLEMS.

ALL PARTS ARE SOLIDLY BOLTED TOGETHER.

Write for the latest reprint of our Engineering Catalog.

THOMAS FLEXIBLE COUPLING CO.

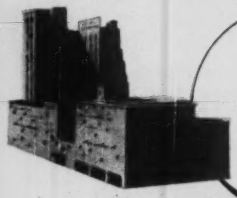
WARREN, PENNSYLVANIA

SPENDS $82,000 SAVES $94,718

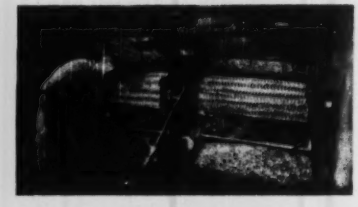
the first year

WITH

PEABODY OIL BURNERS



The Hotel St. George in Brooklyn *saved the cost of the entire installation* **in less than one year by converting from coal to Peabody Oil Burners.**

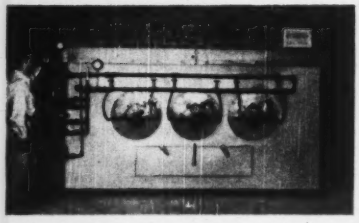


Before . . .

The St. George Hotel used 17,000 tons of bituminous coal a year to fire four 400-HP boilers operated at 75% efficiency. Conversion to oil was based on records dating back to 1928 and included *all* costs of operation.

After

Dirt and dust, along with coal bins and stokers, ash removal problems and maintenance expense, together with high labor costs, have been eliminated by Peabody oil burning equipment that fires these same boilers at 81% efficiency!



PEABODY PRODUCTS INCLUDE: *Automatic Gas and Oil Burners • Pump and Heater Sets • Direct Fired Air Heaters • Gas Scrubbers, Coolers and Absorbers • Burners, singly or in combination, for firing Oil, Pulverized Fuel, and Gas (manufactured, natural, refinery or blast furnace).*

509

OFFICES IN PRINCIPAL CITIES

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct fired air heaters, gas scrubbers, coolers, and absorbers

• Keep Informed

In making the announcement Mr. Brown pointed out that Societe Foster Wheeler Francaise will provide the clients with more efficient service under the direction of personnel with American engineering experience and "know-how." The French company will also provide facilities for European manufacture and make available to the European operator the latest developments and refinements in American design of power plants, chemical plants and oil refineries.

Societe Foster Wheeler Francaise will receive the basic engineering from the parent corporation but will be organized to handle the detailed engineering and construction of the plants with French personnel, the announcement said.

Lincoln Electric Announces Factory Parts Exchange Plan

In order to have guaranteed factory built stators, armatures and other parts available all over the country for welder repair service at lowest possible cost, The Lincoln Electric Co. of Cleveland, Ohio has established a welder parts exchange plan. Old parts may be traded in for factory wound stators, armatures and certain control parts. Standard prices in effect include trade-in allowance which reduces the cost for these production line factory parts below the cost of individual local rewinding and repairing.

This service is available through the 146 Lincoln authorized Field Service Shops in principal cities in 44 different states. Factory trained men are available at each of these Shops for the installation of exchange parts at standard prices. In addition to exchange parts Field Service Shops also provide other welder parts, repair service, preventive service and rental service.

A directory of the 146 Field Service Shops and a complete price list for exchange parts with description of the plan is available from Lincoln Electric, Cleveland 1, Ohio.

• LATEST CATALOGS

New Universal Rotameter Bulletin Now Available

Schutte & Koerting Co. announces the availability of a new Bulletin, 18-RB, which pictures and describes this company's complete line of Universal Rotameters, utilizing the HCF (High Capacity Fluted) Rotameter tube.

The several sections of this bulletin include information on the operation of SK Rotameters, the derivation of the Rotameter Formula, selection of Rotameters and tabular material on SK Rotameter capacities for liquids and gases. Sizes and dimensions are included with information on the application, construction and operation of SK Universal Rotameters.

Copies can be obtained by writing for Bulletin 18-RB to Schutte & Koerting Co., 1166 Thompson St., Philadelphia 22, Pa., Att: Dept. M-A.

X-Y Recorder

To provide information about a new high-speed curve-plotting recorder valuable in research and routine investigations for drawing the relationship between two functions, Leeds & Northrup Co. has issued an illustrated 4-page folder describing its new Speedomax X-Y Recorder.

The folder emphasizes the breadth of possibilities in plotting results, under test, of many types of investigations such as hysteresis loops of iron samples, temperature vs strain in structural materials, vacuum tube characteristics, computer output—in fact,

• Keep Informed

any pair of variables which can be brought to the instrument in the form of d-c voltages.

The operating principles of the instrument, which employs two electrical balancing systems—one for pen motion, the other for chart travel—are described with the help of a simplified schematic diagram.

Specifications, including ranges, response speeds and construction details, are also given. Photographs illustrate the compactness and ease of operation.

A copy of Folder EM9-420(1), describing the Speedomax X-Y Recorder, will be sent on request. Address Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

M-R-C Fan and Water Pump Ball Bearings

Marlin-Rockwell Corp., Jamestown, N. Y., announce their newly issued M-R-C Fan and Water Pump Bearing booklet.

These bearings are designed primarily for the fan and pump position in automotive applications where these two units are each carried on the same shaft. A bearing, however, of this type may be found to be suitable for other applications where it is inconvenient or undesireable to use two single-row bearings; examples of these are saw arbors, drill presses, belt idlers, textile spindles, jet pumps, etc.

The advantage of this design is its compactness and simplicity (the shaft eliminating the necessity for the conventional inner races) and its small outside diameter. The bearing is sealed at both ends, permitting a supply of initial lubricant which will last the entire life of the bearing and dispensing with the necessity for providing grease or oil fixtures in the design.

This booklet contains sketches of 14 different designs of M-R-C Fan and Water Pump Bearings.

M-R-C Fan and Water Pump Bearings are used as original equipment on many fine cars and trucks and are used as replacements.

Vertical Speed Reducers

The Cleveland Worm & Gear Co., 3264 East 80th St., Cleveland, Ohio, just issued a new Bulletin No. 125 announcing two new types of Vertical Speed Reducers designated as NU and ND.

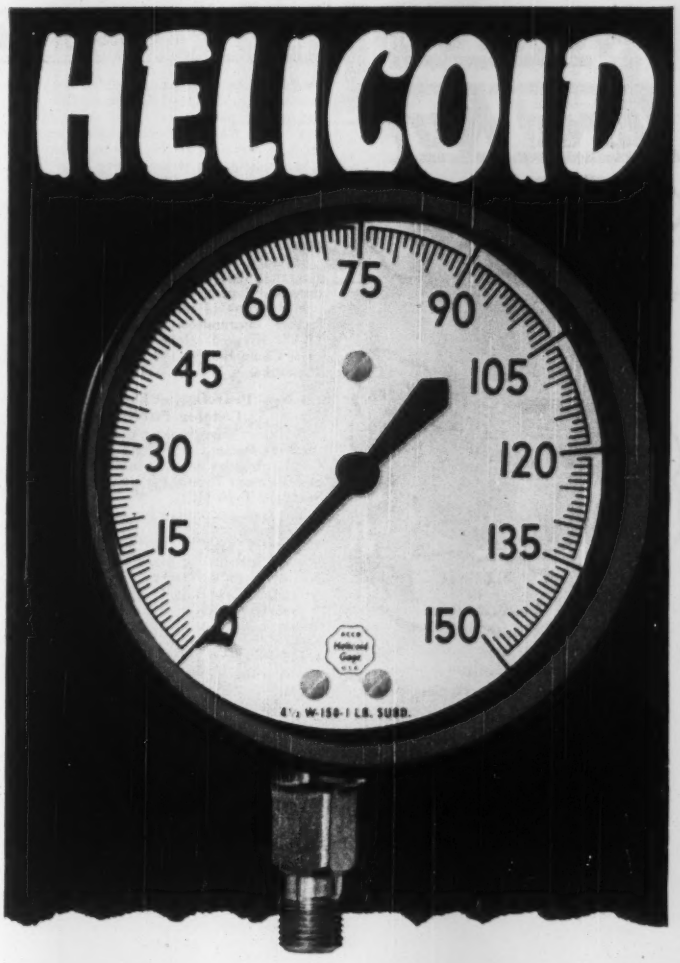
In the design of these new vertical gear shaft worm gear speed reducer types, the experience gained in years of manufacture, application and operation of their predecessors has been fully utilized to produce a sturdy, dependable unit capable of meeting the most severe requirements. By employing heavier gear shaft bearings and by increasing the bearing span while reducing the overhung length of the shaft extension, these units have been provided with capacity to withstand externally applied loads on the gear shafts, whether extended upward or downward, that makes them particularly suited to such equipment as agitators and mixers, and in connection with supplementary low speed spur gear drives, without outboard bearings.

Riveted Roller Chain Assembly

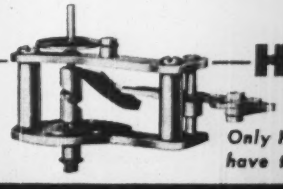
The Baldwin-Duckworth Division of Chain Belt Co. of Milwaukee has just published bulletin #50-6, illustrating and describing the Baldwin-Rex "BA" Riveted Roller Chain Assembly.

The Baldwin-Rex "BA" Assembly is standard riveted roller chain with a special single pin connector link. It is assembled at the two-foot mark and at the end of each basic five-foot length in which this chain is assembled. This new connector has a pin

Continued on Page 56



• *The greatest improvement in pressure gages in 100 years. Write for HELICOID GAGE CATALOG.*



HELICOID

ACCO

Only Helicoid Pressure Gages have the Helicoid Movement

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
Bridgeport 2, Connecticut

TRADE MARK

Stuart's ThredKut

D. A. STUART'S THREDKUT straight, or in rich blend, provides fine finish on tough, stringy materials because its high sulphur content gives it excellent anti-weld characteristics.

In long dilutions THREDKUT delivers long tool life and outstanding performance at low cost on free cutting, high speed operations.

THREDKUT'S exceptionally broad range of usefulness makes it cost less than "cheaper" products in the majority of cases and often eliminates the need for several different types of oils. When it comes to *performance* on the jobs within its range, *none can best it!* Write for details and literature.

100% of All Metal Cutting Jobs Can Be Done at Lower Cost with D. A. Stuart's Wise Economy Plan Ask about it!

OUR 88th YEAR

D. A. Stuart Oil Co.

2741 South Troy Street, Chicago 23, Illinois

• Keep Informed . . .

which can be driven out very easily when assembling or disassembling the chain. This and other important features of the Baldwin-Rex "BA" Riveted Roller Chain Assembly are fully explained in this new bulletin.

In addition to regular five foot basic length sections, the "BA" Assembly is supplied in standard short sections of two, six and ten pitch units. Tables and examples are provided showing suggested combinations of these units for various length drives.

Included in bulletin #50-6 are construction diagrams, illustrations, list prices, specifications and dimensions.

For a copy of this bulletin #50-6, or for further information on the Baldwin-Rex "BA" Riveted Roller Chain Assembly, write Chain Belt Co.; 1600 West Bruce St., Milwaukee 4, Wis.

New Prat-Daniel Dust Collector Catalog Published

A sixteen-page booklet just published by the Prat-Daniel Corp. of East Port Chester, Conn., provides detailed information on the new Valmont Type S Dust Collector and the Standard Type HC.

The booklet contains latest information on the high narrow inlet slot, a feature of the Valmont Type S, claimed to increase collection efficiency in the range below 20 microns. It also describes internal changes and proportionate dimensional revisions of the tube. A nomograph chart is included for determining number of tubes required for a given capacity, temperature and resistance, followed by tables for determining dimensions of the collector for any number of required tubes.

Copies of this new catalog are now available. Request Catalog No. 250S. The Thermix Corp. of Greenwich, Conn., are project and sales engineers for Prat-Daniel.

Flow Meter Handbook

"Principles and Practice of Flow Meter Engineering," by L. K. Spink, published by The Foxboro Co., 182 Neponset St., Foxboro, Mass. Price $7.00. This handbook, widely accepted as a standard text and guide, has just appeared in a new and enlarged edition, the seventh since the book was first published, in 1930. Much new and valuable material has been added, making the book a complete, up-to-date, and authoritative treatise on all phases of flow engineering. Mr. Spink is well known as an engineer who has devoted many years to the study of flow measurement. In the present edition of his handbook, a new section is contributed by R. L. Parshall, inventor of the Parshall Flume, giving design details, operating instructions, and tables for measuring flows through open channels by means of weirs and flumes.

The book covers its field so thoroughly that an 8-page index is required to list the subjects treated in the 416 pages of text and illustrations. All the necessary information is given for calculating an orifice, flow nozzle, Venturi tube, Pitot tube, or even a pipe elbow used for flow measurement. The common pressure tap locations are discussed, and data given to correct for odd tap locations. Liquids, steam or other vapors, and gas, are handled in separate sections. Instructions, curves, and tables are presented in logical sequence and simple manner. Viscosity corrections are furnished in convenient form.

Equations and curves for calculating throttling orifices to be used at critical pressure drops are a new addition to the book. Other new features include a complete section on measurements of fluid flow in metric units, a table of corrections for barometric pressures, a table of pressure multipliers up to 5000 psig, a description of practical methods of applying A.G.A. Gas Measurement Committee Report #2, new and simplified instructions for use of the square-root planimeter on gas meter charts, and pages of examples of typical calculations in flow meter engineering.

New Bulletin Describes SK Water Jet Eductors

A new 36-page bulletin 2-M, pictures and describes the complete line of SK Water Jet Educators for use in the lifting, pumping, mixing and agitating of liquids and the handling of solids and slurries at low cost.

These eductors operate on the jet principle utilizing the energy of one liquid, usually water, under pressure to cause the flow of another.

Photographs, sectional drawings and text describe the application, construction and operation of the numerous types and sizes available. Tables with dimension drawings give complete data on dimensions, connection sizes, weights, prices and capacities. Colored flow diagrams indicate typical applications of the various types in a diversity of industries.

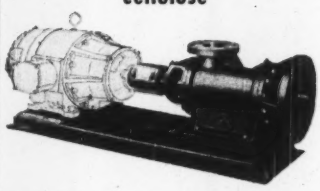
Copies can be obtained by writing for Bulletin 2-M to Schutte & Koerting Co., 1166 Thompson St., Philadelphia 22, Pa., Att: Dept. J-A.

Booklet on Small Motor Selection Available from Westinghouse

A 4-page Small Motor Selector is available from the Westinghouse Electric Corp. The first page of the booklet is devoted to explaining why there are different types of fractional horsepower motors, and the factors to be considered in selecting the right motor for the application.

DE LAVAL-IMO

pumps highly viscous cellulose



Pumping high viscosity fluids is no problem with an IMO.

Suction losses, cavitation, turbulence and internal friction are held to an absolute minimum because of the unique form of the IMO rotors, the large suction opening and the axial flow design of this pump.

Send for Catalog L-C31C-A

1-168

IMO PUMP DIVISION of the DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

• Keep Informed

The center pages, which open to form a large chart, present in tabular form the various types of small motors, together with complete data concerning horsepower range, speed characteristics, torque, reversibility, bearings, mountings, and application.

Typical speed-torque curves for various types of fractional horsepower motors are included, together with information on specialized standard designs for specific applications, such as stokers, washing machines, hoists, etc.

For a copy of this booklet (B-3075-C) write the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

New Yale Bulletin Details Pak-Loader Fork Truck System for Palletless Handling

The Yale & Towne Manufacturing Co., Philadelphia Division, announces a new four-page bulletin describing the Pak-Loader Fork Truck System of palletless handling. Twelve pictures and four line drawings illustrate the application of the Pak-Loader System to the transporting and tiering of loads of sacks, cartons, bails, and drums. Text, photos, and line drawings describe and illustrate two typical handling cycles and clearly indicate how the palletless system, comprising fork trucks equipped with pusher mechanisms and several steel plates per truck saves storage space, manual loading, demurrage, and handling costs.

Four photographs follow the Yale Pusher Fork Truck as a load of sacks is removed from the storage area, picked up on a special steel plate, and unloaded into a freight car. The operation of the pusher device when pushing loads off the forks is described and illustrated in detail.

The elements of the Pak-Loader System are presented in an overall inclusive manner that permits plant managers, shipping supervisors, traffic engineers, and materials handling experts in specific industries to apply the Pak-Loader System to their own special requirements.

For a copy of the new bulletin write to The Yale & Towne Manufacturing Co., Philadelphia Division, Roosevelt Blvd. & Haldeman Avenue, Philadelphia 15, Pa.

Steel and Alloy Plate Fabrication

Designed mainly for engineering personnel, this brochure offers a pictorial story of the fabrication of steel and alloy tanks and pressure vessels. Stainless steel, monel, nickel, copper, aluminum, Hastelloy and clad steels are among the corrosion resistant alloys presented. Also of special interest are comprehensive corrosion data charts. Nooter Corp., 1432 So. Second St., St. Louis 4, Mo.

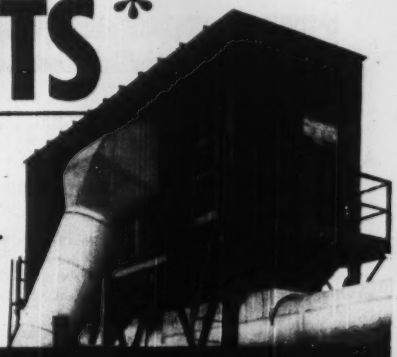
Time Cycle Controllers of Greater Versatility

A new 16-page bulletin on "Flex-O-Timer" Time Cycle Controllers has just been released by the Taylor Instrument Companies, Rochester, N.Y. It features an instrument which is particularly adaptable to those applications which have a multiplicity of functions to perform during the course of a cycle.

The new literature presents a whole new family of "Flex-O-Timer" Time Cycle Controllers. They are available in five different models for applications requiring all-electrical or all-pneumatic, or any specified combinations of each. The bulletin shows how they control any particular group of functions which may be required in the sequence of a manufacturing operation—according to a predetermined schedule and over a specifically timed period.

Continued on Page 5

TURN DUST INTO PROFITS*



Hundreds of plants have done it... with Pangborn Dust Control!

* **$13,951**

Pangborn Dust Control eliminates dust, pays for its operation, and *earns $13,951 each year* on charcoal salvage for this manufacturer!†

* **$12,752**

In a large grain mill, Pangborn Dust Control eliminates dust hazards and *earns a profit of $12,752* annually, salvaging grain formerly lost as dust!†

* **$7,691**

Based on operating costs before and after Pangborn Dust Control was installed, savings, other than salvage, for this metal plant *run $7,691 a year!*†

* **$5,103**

Asbestos salvaged to the tune of *$5,103 yearly* . . . dust completely eliminated . . . that's the Pangborn Dust Control profit story for this Asbestos manufacturer!†

HOW ABOUT YOUR PLANT?

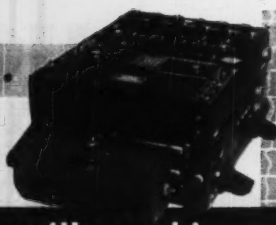
Let us make a "Dust Pocket" survey in *your plant*. There's no obligation! Pangborn engineers show you how the right Pangborn Dust Control equipment saves you money . . . boosts your profits! For full information and your *free copy* of Bulletin 909A on the control of industrial dust, write today to: PANGBORN CORPORATION, 289 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment.

THE DUST HOG from stealing profits with

Pangborn

DUST CONTROL



All you need...

for complete oscillographic recording

The 5-8 Oscillograph, long the standard of oscillographic recording, has been improved to meet the expanding demands of modern research. The NEW Type 5-8 Oscillograph has all the inherent capabilities you need to record rapidly changing phenomena such as vibration and dynamic strain.

A few of the newest features are:

QUICK-CHANGE TRANSMISSION—16 record speeds over range of 120:1

FULL RESILIENT MOUNTING makes possible use of super-sensitive galvanometers

CHART TRAVEL INDICATOR provides continuous indication of chart motion

NEW GALVANOMETER STAGE takes all Hathaway galvanometers for recording milliamperes, microamperes, and watts.

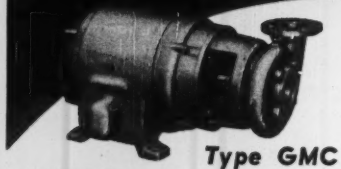
NEW RECORD-LENGTH CONTROL and NUMBERING SYSTEM for long, trouble-free service

All the other valuable features characteristic of the 5-8 are retained. Investigate the NEW Type 5-8 and its 170 types of galvanometers.

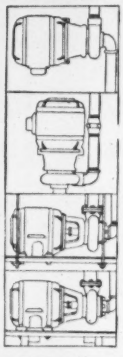
Write for Bulletin 2B1AK

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

HARD to BEAT for COMPACTNESS • LONG LIFE • BRILLIANT PERFORMANCE



READILY INSTALLED ANY POSITION



Type GMC
AURORA CENTRIFUGAL CLOSE-COUPLED PUMPS

These Close-Coupled Pumps "by Aurora" are ideal for a multitude of applications, particularly where the saving of space is important, or location is unconventional. Operate smoothly in any position. Sturdy bracket insures permanent pump-motor alignment. Ready access to glands—extra deep stuffing box, hydraulically balanced. High quality throughout. Available for screwed or flanged connections. Require small amount of metal for handling corrosives.

APCO TURBINE-TYPE PUMPS Here's the Pump for "1001" duties. SIMPLE—only one moving part, the impeller. Capacities to 150 G.P.M. Heads to 600 ft. Slight change in capacity against drastic head variations.

Write for
CONDENSED CATALOG "M" or GMC Bulletin 120

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS
AURORA PUMP COMPANY
96 Loucks Street, AURORA, ILLINOIS

• Keep Informed

Photographs of complete instruments, sectional views and application drawings are generously used to illustrate the versatility of the instrument. Advanced ideas and refinements in design provide for greater ease of adjustment and for the operation of more intermediate functions.

Write for Bulletin 98154 "Taylor Flex-O-Timer Time Cycle Controller" to Taylor Instrument Companies, Rochester 1, N.Y.

Micro Ball Bearings

New Hampshire Ball Bearing, Inc., announce their new Technical Bulletin No. 50 on "Micro" Ball Bearings, now available for distribution.

This 12-page catalog describes a full line of standard and special ball bearings, reported to be the only fully ground miniature bearings made in this country, including the only miniature Conrad (retainer type) ever manufactured in the U. S.

Designs include Conrad Radial, Full Race Radial, Extra Light Radial, Angular Contact, Self-Aligning and Pivot, in outside diameters $^1/_8$" to $^3/_8$", of alloy steel, stainless steel and beryllium copper (non-magnetic), with data on tolerances, loads, speeds, life, lubrication, mounting, fits, etc. Copy on request to New Hampshire Ball Bearings, Inc., Peterborough 1, N.H.

Triplex Direct Flow Pumps

The Aldrich Pump Co., 29 Pine St., Allentown, Pa. has just released a 6-page Data Sheet giving full information on their new 5" Stroke Triplex Direct Flow Pump. Information presented includes: construction and design, specifications, dimension drawings, illustrations, selection chart and table, and drive specifications.

Edward Issues Bulletin on New All-Purpose Fig. 444 Valves

A new bulletin describing in detail the new Edward Fig. 444 series globe and angle stop valves has just been issued by Edward Valves, Inc., East Chicago, Ind.

The bulletin gives design details, dimensional data, material specifications, and list prices for the new forged steel valve series which is built in both 600 and 1500 lb sp classes. The valves are of drop forged steel construction and can be had with either bolted or union bonnets and with either screwed or socket welding ends. The new valve series is of O. S. & Y. type with bolted glands for ease of packing.

Copies of Bulletin 501 may be had by writing to Edward Valves, Inc., East Chicago, Ind.

Standardaire Blowers

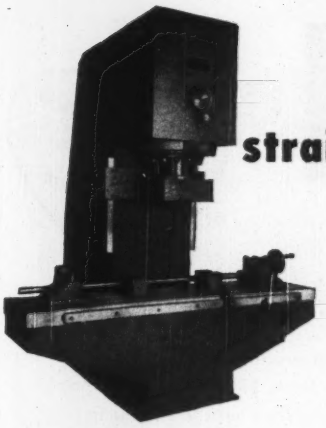
A new Bulletin, No. 86, has just been released by Standard Stoker Co., 370 Lexington Ave., New York 17, N. Y. This bulletin is a handy Selection Chart which lists the various capacities possible in the Standardaire Blower when direct connected to standard speed motors.

New Resistance Welding Control Equipment

New Westinghouse electronic resistance welding control equipment, both synchronous and non-synchronous, is described in detail in booklet B-4309.

Basic equipment in the control circuit includes a sequence-weld-timer panel and a means to fire the ignitron tubes in the power circuit. Auxiliary control panels can be readily added to meet specific job requirements. This booklet lists and discusses the functions of both basic and auxiliary control panels.

For a copy of this booklet (B-4309) write Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

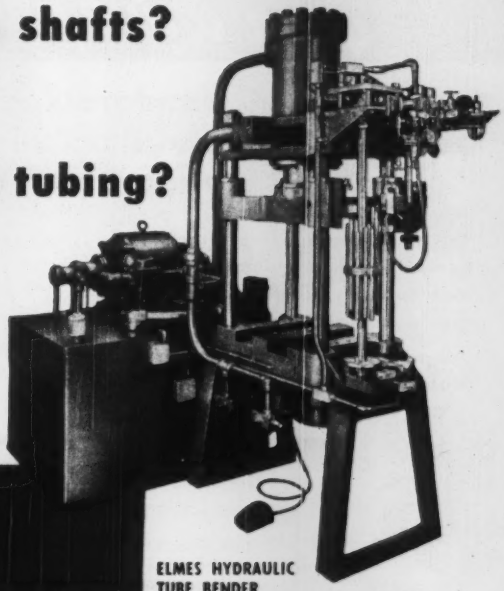


straightening shafts?

bending tubing?

ELMES OPEN-SIDE PRESS

Versatile 150-ton Model 6430, shown with fixtures for shaft straightening. 96"x24" bed. 17"x18" platen. Opening: 32". Stroke adjustable to 20".



There's an ELMES HYDRAULIC PRESS

ELMES HYDRAULIC TUBE BENDER

For forming auto exhaust pipes and other tube bending applications. A special Elmes indexing device regulates depth of bends; provides 1 to 12 different depths in succession, with automatic reset. Double cushion allows two bends to be made simultaneously.

Producing special-purpose equipment is an *important part* of Elmes service to the metal-working industry. The two examples illustrated here do not begin to show the broad and varied range of Elmes Special-Purpose Press application.

Elmes Special-Purpose Hydraulic Presses may be *standard* designs modified for specific kinds of work. They may be existing designs with modifications in any of *many* features. Or they may be entirely *new* designs. With thousands of drawings for reference, and with existing patterns, Elmes can furnish you with special presses *without* burdening development costs.

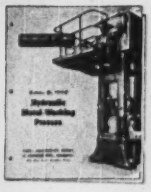
There can be no substitute for long experience when it comes to solving new problems. That's why special Elmes equipment is so *favorably* known, so *widely* used, throughout the metal-working industry. If *you* have a special metal pressing operation, why not put your problem up to Elmes? Elmes ingenuity and skill are positive assurances of *press performance at its best!*

ENGINEERED BY ELMES

Good Hydraulic Production Equipment Since 1851

Write for New ELMES Bulletin No. 1010B

"HYDRAULIC METAL-WORKING PRESSES"



Illustrates, describes and gives major specifications on Elmes hydraulic single-action, double-action, and triple-action presses; standard designs; special designs; automatic feeds. Your Elmes Distributor can supply you, or request from us direct—on your business letterhead, please.

AMERICAN STEEL FOUNDRIES • ELMES ENGINEERING DIVISION

Distributors in Principal Industrial Centers • Also Manufactured in Canada

1150 Tennessee Ave., CINCINNATI 29, OHIO

METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

A simple STOCK answer to your drive problems

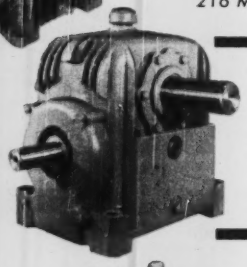
...available from stock at an amazingly low cost per horsepower

444 standardized gear sets
Over 190,000 standardized reducers
Only 58 standardized mountings

The double-enveloping principle of Cone-Drive Gears also gives you higher load capacity, longer life, less weight, greater compactness.

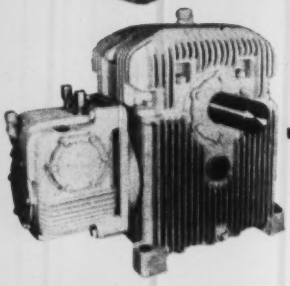
All parts for a given center distance—gears, mountings, bearings, housings, fan-cooling attachments and water cooling coils (for continuous, high-load operation), etc.—are standardized whether you use pinion over or under, gear shaft vertical or horizontal, single or double extended shafts, right or left hand.

192 Models; 8 Ratios (5/1 to 50/1); 2" Center Distance.....	**.06 to 3 hp**
192 Models; 8 Ratios (5/1 to 50/1); 2½" Center Distance.....	**.1 to 5½ hp**
216 Models; 9 Ratios (5/1 to 60/1); 3" Center Distance.....	**.17 to 9 hp**



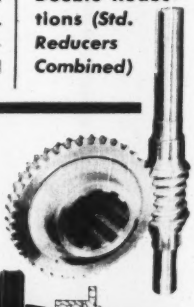
2539 Models (1421 of these may also be fan or water-cooled)
9 Ratios (5/1 to 60/1) in 4" Center Distance
10 Ratios (5/1 to 70/1) each in 5" to 12" Center Distances
8 Ratios (10/1 to 60/1) in 15" Center Distance
9 Ratios (8/1 to 60/1) in 18" Center Distance

2 to 636 hp @ 1150 rpm (HP at higher and lower input speeds approximately in proportion)

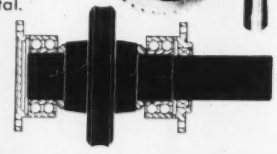


Ratios up to 4900/1 (186,250 reducer combinations) Max. Output Torque 4,000 to 244,600 in.-lbs. Input—½ to 68 hp. Water cooling available for either or both primary and secondary units. 2½" and 3" center distance primaries are special

Double-Reductions *(Std. Reducers Combined)*



STANDARDIZED GEAR SETS FROM STOCK—A size and ratio to fit most needs. .06 to 636 hp. 7 to 10 ratios in each size (5/1 to 70/1). Remarkably compact. Available with standardized interchangeable mountings with anti-friction bearings. Single or double extended pinion or gear shafts, pinion over or under, gear shaft vertical or horizontal.



Complete specifications and prices on request. Please give approximate hp range, input speeds, ratio and approximate quantities which would be required.

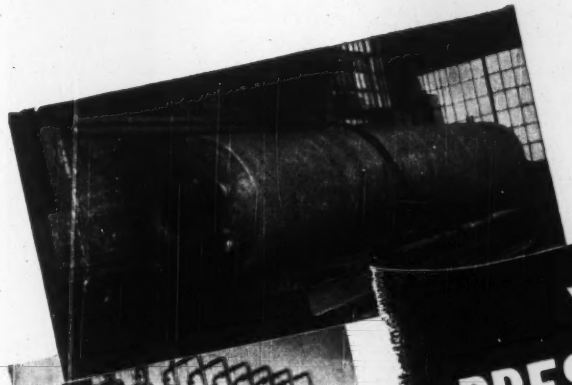
CONE-DRIVE GEARS

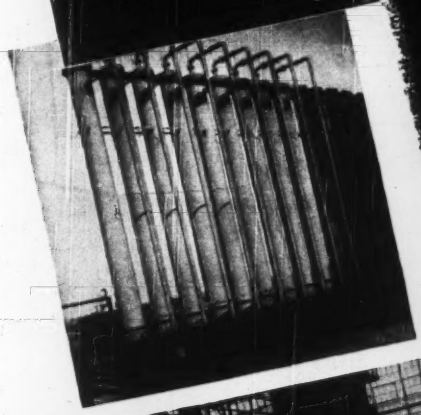
Division, Michigan Tool Company

DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

7171 E. McNichols Road • Detroit 12, U.S.A.

Vogt



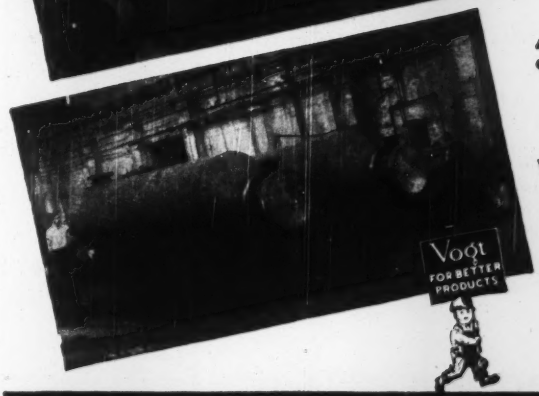


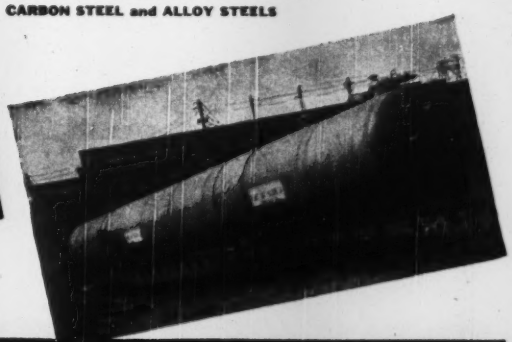
WELDED PRESSURE VESSELS

Top quality power and process plant equipment for safe operation at high or low pressures and temperatures is produced here for leading Petroleum Refineries, Chemical Plants, and Power Plants the world around.

A growing preference for Vogt welded pressure vessels is due to skilled personnel, powerful X-ray apparatus to control weld quality and modern stress relieving furnaces, combined with complete laboratory facilities for tests of welds.

A. P. I.—A. S. M. E. and A. S. M. E. CODES
CARBON STEEL and ALLOY STEELS



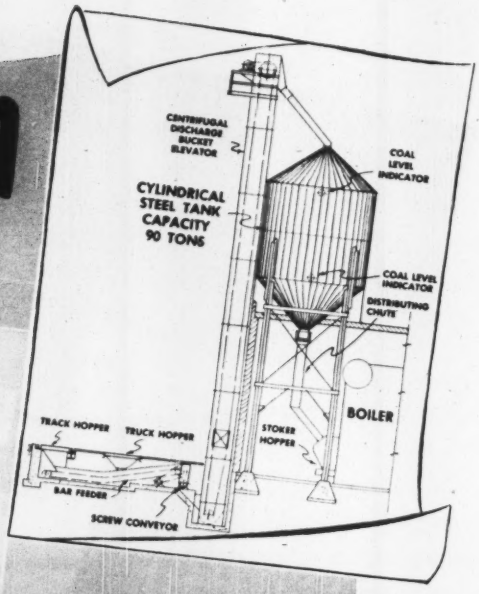


HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE 10, KENTUCKY
BRANCH OFFICES NEW YORK PHILADELPHIA CLEVELAND CHICAGO ST LOUIS DALLAS

Simplification

is the KEY

TO LOWER COAL HANDLING COSTS

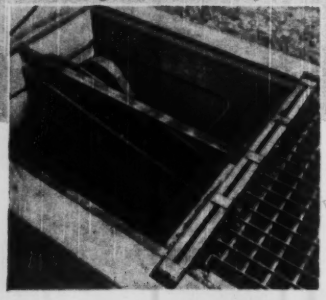


See How G-W does it with Four basic designs!

This installation at Universal Match Corporation, Hudson, N.Y., is one of **four basic types* . . . evolved by G-W to simplify design, manufacture and erection of dependable coal storage and handling equipment. G-W engineers recommend its cylindrical steel tank type of storage because it required the least amount of space and attention . . . is clean and economical to install and maintain.

Auxiliary equipment consists of feeder and conveyor from truck and track hoppers and bucket elevator to 90 ton tank at 25 tons per hour. Coal is discharged direct from storage to stoker hopper.

Showing bar feeder in hopper delivering coal to screw conveyor.



4 BASIC WAYS TO CUT COAL HANDLING COSTS

*The other three G-W basic types of coal storage systems are: reinforced concrete silo, vitrified tile silo, suspended steel bunker . . . the result of over 135 years of experience in installing hundreds of coal handling systems. Why not consult a G-W engineer? He will be glad to show you how one of these four basic designs can simplify your coal handling problems . . . reduce your costs.

4

Bulletin No. 300 describes 14 case histories utilizing these 4 G-W basic types. Write for your copy today.

GIFFORD-WOOD CO.

SINCE 1814

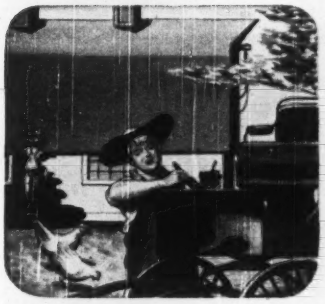
NEW YORK 17 — 420 LEXINGTON AVE.

Factory: Hudson, N. Y.

CHICAGO 6 — 565 W. WASHINGTON ST.

G-W HANDLES IT . . . faster • easier • cheaper

6339



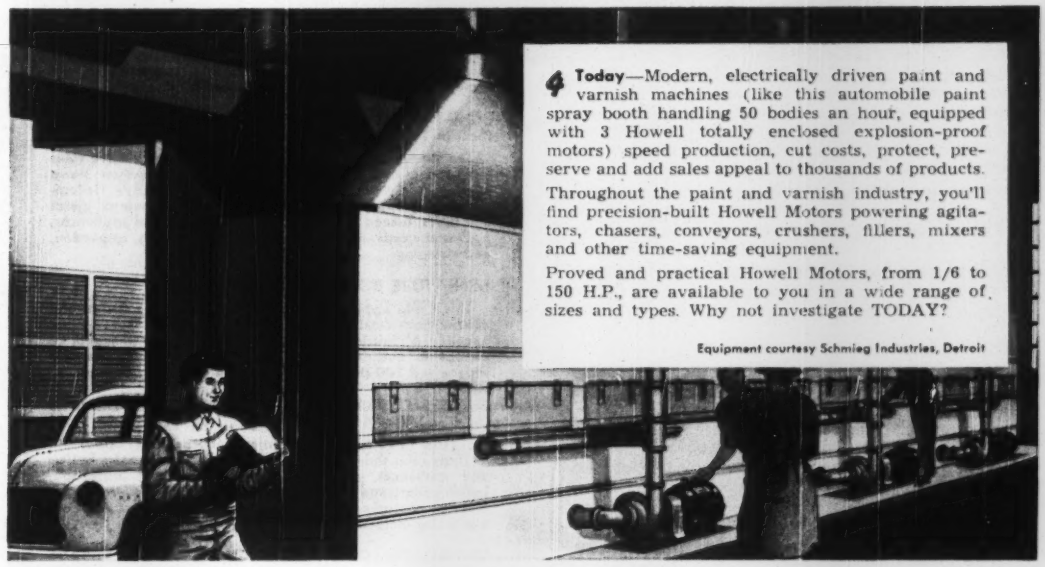
1 **1875**—For centuries, hard labor and a paintbrush were man's main means of adding beauty and color. But, with the industrial revolution at hand, new devices were sorely needed to break this bottleneck.

2 **1900**—The artist's airbrush was born. On its heels came the paint spray gun. Both products, strangely enough, stemmed from the atomizer used by doctors to prevent colds. Painting swung into high gear.

3 **1915**—Portable paint-spraying equipment was introduced in this, the year Howell "Red Band" Electric Motors arrived. Soon these rugged motors made important contributions to this and other industries.

PAINT . . . protects, preserves, decorates and sells!

(AND HOWELL MOTORS HELP SPEED MODERN PAINTING PROCESSES—CUT COSTS)



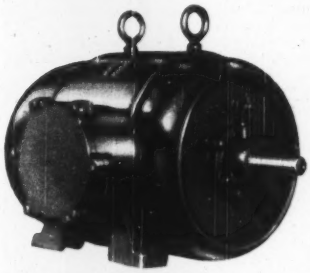
4 **Today**—Modern, electrically driven paint and varnish machines (like this automobile paint spray booth handling 50 bodies an hour, equipped with 3 Howell totally enclosed explosion-proof motors) speed production, cut costs, protect, preserve and add sales appeal to thousands of products.

Throughout the paint and varnish industry, you'll find precision-built Howell Motors powering agitators, chasers, conveyors, crushers, fillers, mixers and other time-saving equipment.

Proved and practical Howell Motors, from 1/6 to 150 H.P., are available to you in a wide range of sizes and types. Why not investigate TODAY?

Equipment courtesy Schmieg Industries, Detroit

Free enterprise encourages mass production, supplies more jobs—provides more goods for more people at less cost.



Howell totally-enclosed, explosion-proof motors for use where inflammable liquids or gases are handled or stored.

HOWELL MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.

Precision-built Industrial Motors Since 1915

HOWELL Red Band MOTORS

For Publication in March-April

1949 ASME BOILER CONSTRUCTION CODE

The indispensable reference for those who design, construct, install, inspect, and use boilers and other pressure vessels.

Formulated by a Committee representing boiler manufacturers, insurance companies, and law enforcement agencies.

Issued in nine sections, with all changes and additions of the past three years incorporated in its pages.

Adopted or accepted by more than half of the States, many of the Cities and the Canadian Provinces.

Published by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, New York

POWER BOILER CODE, INCLUDING RULES FOR INSPECTION (Sections I and VI) $2.75

These rules apply to the boiler proper and pipe connections up to and including the valve or valves as required by the Code, superheaters, reheaters, economizers, and other pressure parts connected directly to the boiler without intervening valves; welding; inspection; and stamping. An appendix to the Code provides tables of working pressures; methods of calculating efficiency of joints; a method of checking safety valve capacity; hydrostatic test procedure; specifications for fusible plugs; suggestions covering existing installations; examples of methods of computing shell openings; examples of computing allowable loading on structural attachments to tubes; and specimens of approved manufacturers' data report forms.

MATERIAL SPECIFICATIONS (Section II) $5.00

The 79 specifications in this Section are for the ferrous and non-ferrous metals which must be used when boilers and pressure vessels are constructed to Code rules.

BOILERS FOR LOCOMOTIVES (Section III) $1.00

Materials, working pressures, thickness of plates and tubes, joint efficiency, braced and stayed surfaces, riveting, safety valves, fittings, hydrostatic tests, welding, and stamping, are some of the construction details covered by this Code.

LOW-PRESSURE HEATING BOILER CODE (Section IV) $1.00

The steel plate and cast iron boilers for which these rules were formulated are used exclusively for low-pressure steam heating, hot water heating, and hot water supply. Recommendations apply to materials, minimum thickness of plates and tubes, braced and stayed surfaces, fittings and appliances, hydrostatic tests, setting and installation, welding, inspection, and stamping.

MINIATURE BOILER CODE (Section V) $.75

This Code applies to some of the important design and construction details of fired pressure vessel which do not exceed 16" inside diameter of shell, 42" over-all length of outside to outside heads at center, 20 sq ft water heating surface and 100 psi maximum allowable working pressure.

SUGGESTED RULES FOR CARE OF POWER BOILERS (Section VII) $1.25

(This 1949 edition is identical with the 1946 Code)

These rules show how to operate and maintain steam boilers and appliances, conduct internal and external inspection; install boilers, and prevent causes of boiler failures. A recommended procedure for feedwater analysis treatment and control is also included.

UNFIRED PRESSURE VESSEL CODE (Section VIII) $2.25

Vessels to which this Code applies are (1) those subject to external pressures and (2) those for gas and liquids at temperatures of —20F and below. Details covered include materials, safety devices, working pressures, riveted joints, dished and flat heads, braced and stayed surfaces, nozzle openings, tests, inspection, stamping, and welding. In the appendix are tables of dimensions, and of working pressures; examples of methods of computing shell openings; rules for bolted flanged connections; procedure for making hydrostatic tests; and samples of manufacturers' data report forms.

WELDING QUALIFICATIONS (Section IX) $ .90

The rules in the first part of this Code apply only to the manual application of the arc- and gas-welding processes and to those ferrous metals which in their unwelded condition will meet the requirements of the guided bend test prescribed in the Code. The second part outlines types of tests which should be made to determine an operator's ability to produce sound welds.

ASME BOILER CONSTRUCTION CODE (Sections I to IX) $14.50

This Combined Code makes available in convenient form the nine sections listed and described on this page.

T F

...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier ...better*. Coupon brings lots of facts.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS • *General Offices & Works:* Chicago 90, Ill. (P.O. Box 485). *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif. *District Offices:* New York: 50 Church Street. Philadelphia: Broad Street Station Bldg. Pittsburgh: First National Bank Bldg. Chicago District Sales: 208 S. LaSalle Street. Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg. San Francisco: Russ Bldg.

Please send a copy of your new welding fittings and forged steel flange catalog 484 .

Name_____

Position_____

Company_____

Street Address_____

City_____ Zone____ State_____

, Mail to Taylor Forge & Pipe Works
P.O. Box 485, Chicago 90, Ill.

504-0350

Why Bundyweld is

When there's even a hint that your product, design or production problem calls for a tubing, think of Bundyweld Tubing!

However you use it—in a design, structural or functional application—Bundyweld delivers all-round rugged, long-lived, *dependable* performance through thick and thin, heat and cold, stress and strain.

In short, no other tubing can match all Bundyweld's advantages, for no other tubing is made like Bundyweld . . . as witness below.

BUNDYWELD'S GRAND WITH DESIGNERS OF BRAKES— IT FIGHTS OFF FATIGUE FROM VIBRATION AND SHAKES.

Every automobile produced today contains an average of 20 parts of Bundyweld. More, Bundyweld is in the hydraulic brake line systems of 95% of today's cars! If strength and high resistance to vibration fatigue are *the* factors in your tubing needs, you need Bundyweld.

IT'S DUCTILE, IT'S LIGHT, AND IT'S EASY TO BEND, YOUR SAVINGS IN COSTS ARE A FINE DIVIDEND.

Easy-to-handle Bundyweld fabricates like a charm. It bends more readily and takes more bending. It gives you a competitive edge from lowered fabrication costs, whether you're concerned with beer coils, tubular frames, radiant heating systems, or just a "gimmick" made from a tubing.

First, a single strip of basic metal, coated with a bonding metal, is . . .

rolled twice around into a tube of uniform thickness, then . . .

passed through a furnace. Bonding metal fuses with basic metal, presto—

Bundyweld . . . double-walled and brazed through 360° of wall contact.

the dependable tubing

NO LEAKS UNDER PRESSURE—FROM WITHIN OR WITHOUT; OF BUNDYWELD QUALITY THERE IS NO DOUBT.

Special note to users of beer coils, gas and refrigerant lines, compressor and connector lines and the like! Halogen vapor leak detector tests, accurate for 1/100 ounce leak *per year*, score Bundyweld 'way at the top for leakproof performance. It's rolled up *tight* and brazed through 360° of wall contact.

WE CHECK EVERY INCH WITH A TRUE EAGLE EYE— YOU GET THE DIMENSIONS THAT YOU SPECIFY.

Use of close-tolerance, cold-rolled strip assures amazingly consistent wall thickness, I.D., and O.D. in Bundyweld. Coating of finished tube, inside and out, is clean and bright. You get extra savings through a minimum of costly inspections.

WE—LITERALLY—LATERALLY ROLL IT UP DOUBLE, GAIN GREAT EXTRA STRENGTH THAT FREES YOU FROM TROUBLE.

Yes, it's double-walled from a single strip . . . extra-rugged and strong. Your key to a smarter, sturdier, better product —or to faster production, at less cost—may well lie in an application of Bundyweld somewhere along the line.

So . . .

If *your* tubing job needs a neat panacea,
Check Bundyweld fast . . . 'tis a brilliant idea.
You can get it in nickel, or steel, or Monel,
Add a plus to your product that really will sell.

FREE! We've a new 20-page booklet giving all the facts and data on Bundyweld Tubing, plus a list of tested Bundyweld applications that will give you a real fill-in on what our tubing can do. For your copy, or for queries on a possible use of Bundyweld Tubing, just call or write . . .

Bundy Tubing Company, Detroit 14, Michigan.

Bundyweld® Tubing

DOUBLE-WALLED FROM A SINGLE STRIP

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Philadelphia 3, Penn.:*** Rutan & Co., 404 Architects Bldg. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 3628 E. Marginal Way ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 881 Bay St. • **Bundyweld Nickel and Monel Tubing is sold by distributors of Nickel and Nickel alloys in principal cities.**

Announcing...

19th
NATIONAL POWER SHOW

(NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING)

Grand Central Palace, New York
Nov. 27-Dec. 2, 1950

Advance announcement to previous exhibitors has brought an immediate response—nearly 300 leading manufacturers have already engaged exhibit space at this important event.

Now Under Auspices of A.S.M.E.

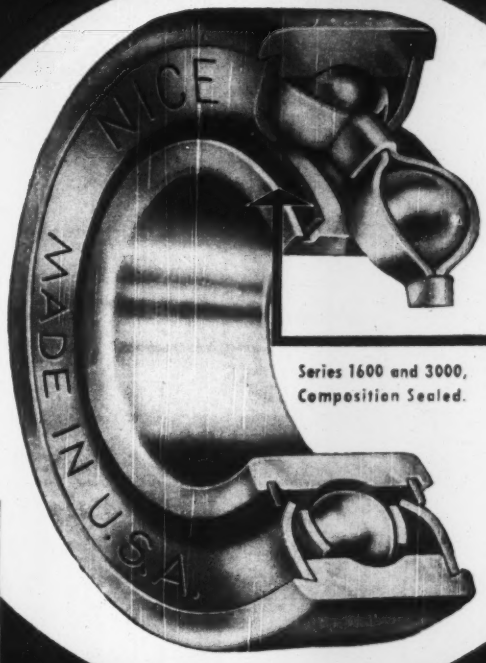
The Power Show will be held this year for the first time under the auspices of The American Society of Mechanical Engineers and held in conjunction with and at the same time as the Annual Meeting of the Society in New York.

Reserve Your Space NOW!

Choice spaces are still available and now is the time to plan for an exhibit. See and meet leading power engineers and actually show them through personal demonstrations the merits of your products. Six days of concentrated selling! Ask now for diagram of available spaces.

Management, International Exposition Co. • Grand Central Palace, New York 17, N. Y.

field-tested and proven...



Series 1600 and 3000, Composition Sealed.

NEW!

COMPOSITION SEAL*
(OIL RESISTANT SYNTHETIC RUBBER COATED FABRIC)
*PATENT APPLIED FOR

NICE

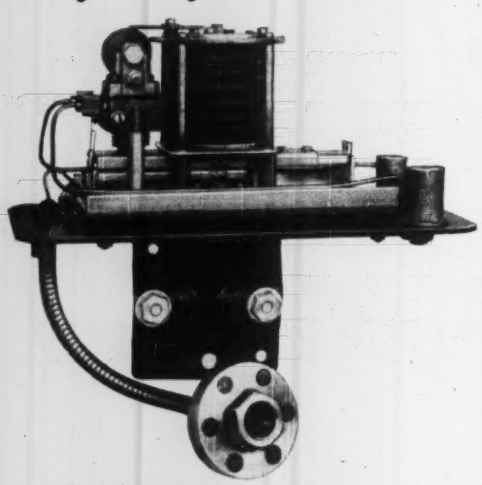
NICE "ground all over" close tolerance "1600" series bearings were especially designed to provide a line of low cost yet high quality bearings for adaptation to a majority of precision bearing applications. Series "3000" are relatively inexpensive unground radials of the same "precision type" construction.

WRITE FOR NEW CATALOG NO. 140

NICE

NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA

Changing temperatures or pressures instantly and accurately measured by Taylor TRANSAIRE* Transmitters



PRESSURE:

New Taylor TRANSAIRE Pressure Transmitter with narrow range spans lets you measure and transmit minute pressure changes up to 1000 feet. Works on simple force-balance principle. Accurate to ½% of the selected short range span (*conventional devices are only accurate up to ½% of upper range limit*). Sensitive to pressure changes of ½" water. Here's accuracy and sensitivity never before possible in pressure measurement—plus the convenience of suppressed ranges at high pressure levels.

SEVEN IMPORTANT ADVANTAGES:

1. Range spans of 20 and 40 psi available throughout range limits of 35 to 415 psia.

2. Volumetric type pressure system is extremely accurate, practically clog-proof, has corrosion-resistant 316 stainless steel diaphragm.

3. Temperature and barometric compensation for higher accuracy of measurement and control.

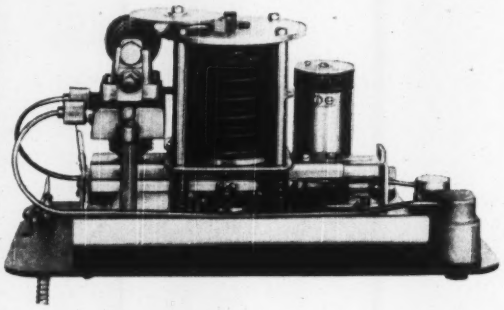
4. Perfect for many jobs, especially thin fractionating columns.

5. No individual calibration of receivers or controller—thanks to standardized 3 to 15 psi output air pressure.

6. Simple screwdriver adjustment for shifting the operating ranges.

7. Interchangeable manifold assemblies make 20 and 40 psi range spans optional.

*Trade-Mark



TEMPERATURE:

New Taylor TRANSAIRE Temperature Transmitter with Speed-Act* lets you measure and transmit smallest temperature changes up to 1000 feet with instant accuracy! The *only* temperature transmitter that gives you:

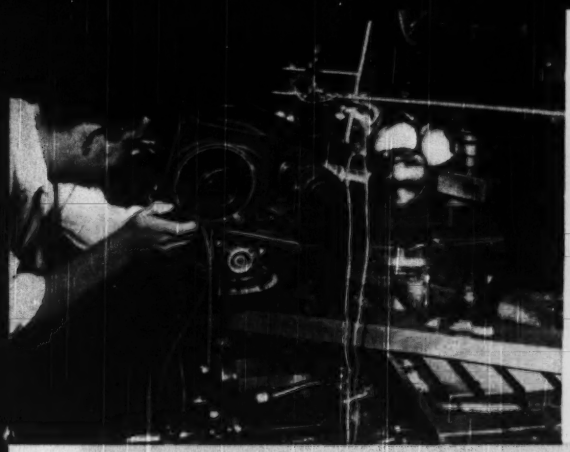
1. DYNAMIC ACCURACY—which means the accuracy of an instrument in measuring changing or dynamic conditions. Transaire Dynamic Accuracy is unparalleled. Solves the problem of process engineers who realize that an instrument accurate to a fraction of a degree in measuring static conditions can be in error by many degrees when temperature is changing.

2. DYNAMIC COMPENSATION—which means ability to compensate for inherent lags both in measuring system and rate of heat transfer of process medium. Transaire does this by introducing derivative action (Speed-Act) into the *measuring* circuit. The result is Dynamic Accuracy, with a speed of response seldom thought possible which permits much closer automatic temperature control.

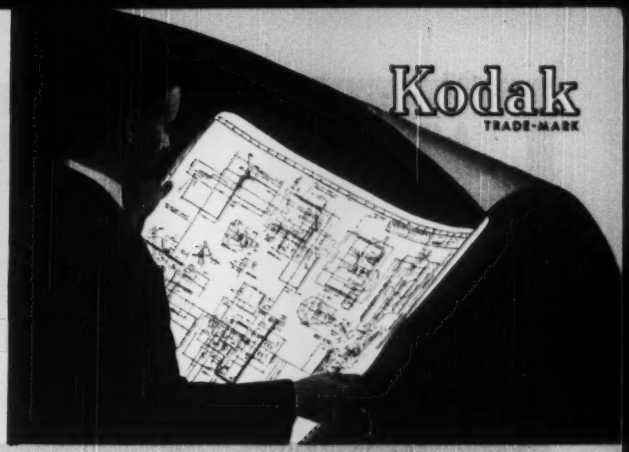
▼ ▼ ▼

For complete details, write for **Bulletin 98140** on TRANSAIRE Temperature Transmitter, and **Bulletin 98099** for TRANSAIRE Pressure Transmitter. Ask your Taylor Field Engineer! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST



IT HELPS IMPROVE PRODUCTS—High speed movies provide a record of motion far too fast to see. With the Kodak High Speed Camera, a second becomes three minutes, so you can see and analyze rapid movement—spot faulty action and points of excessive wear—see ways to make a better product.



IT COPIES DATA IN SECONDS—Engineering drawings, shop orders, specifications, records, and letters of all kinds can be copied fast, and with utmost accuracy. Photocopying with Kodagraph Papers, Cloths, and Film saves time, protects originals from wear and tear—even permits producing clean, legible copies from faded or worn material.

How photography's *Lightning Speed* works for business

HERE YOU SEE a few examples of how the speed of photography serves industry. In addition, its accuracy is used in copying drawings, documents, and data of all kinds. Its ability to reduce can put records on microfilm and save 98% of filing space.

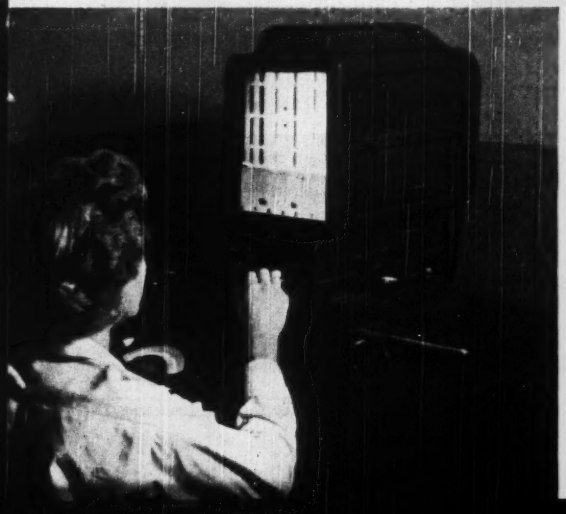
These and the other unique qualities of photography are helping cut costs, improve products, speed production, and stimulate sales. If you would like to know more about how it could serve you, write for literature or for specific information which may be helpful to you. Eastman Kodak Company, Rochester 4, N. Y.

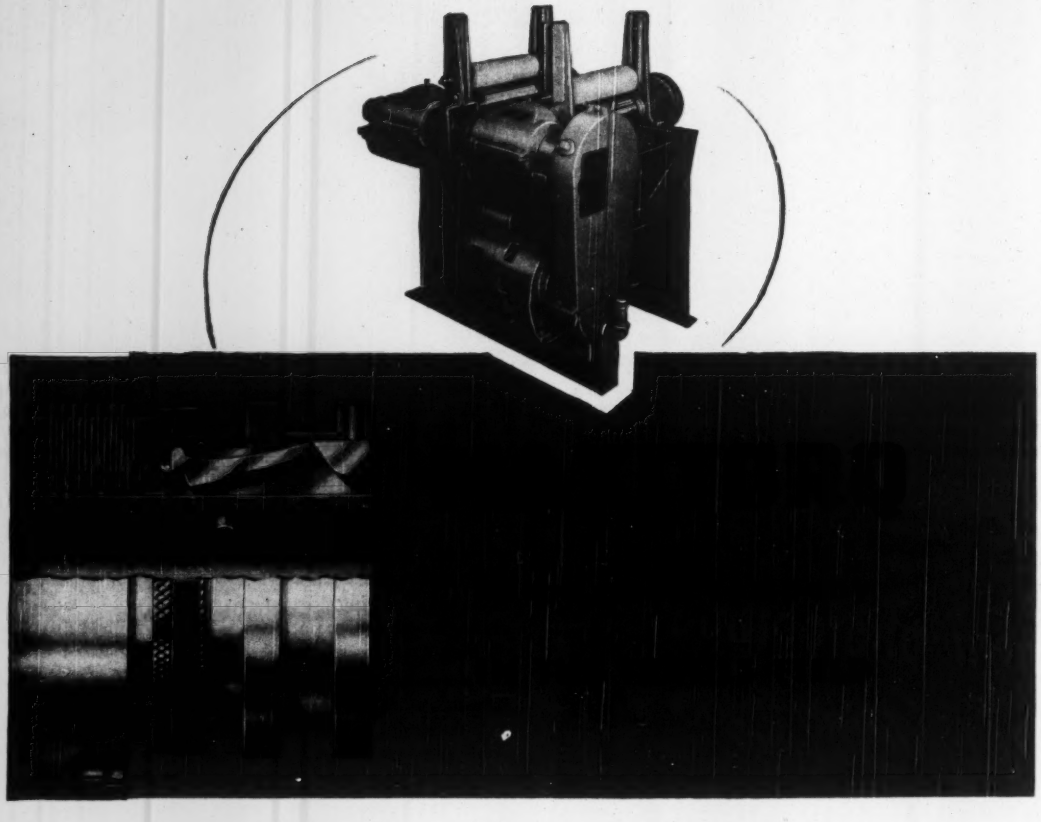
FUNCTIONAL PHOTOGRAPHY

—serves industrial, commercial, scientific progress

IT ANALYZES CHEMICALS IN A FLASH—Spectrography with Kodak Spectrum Analysis Film and Plates quickly determines the composition of almost all materials. It provides a means to make frequent production-line analyses. It can maintain a check on specifications and speed up output.

IT RECORDS THE FLICK OF INSTRUMENTS—The swift swing of the galvanometer mirror or cathode-ray tube beam is not too fast for photography. Readings of these instruments are quickly recorded on Kodak Linagraph Films and Papers so that they can be studied and full advantage taken of the facts that they reveal.





For nearly a half century, many power transmission problems have been presented to Carlyle Johnson engineers by builders of textile machinery. The Maxitorq floating disc Clutch seems to be well suited to this specific field . . . as is evidenced by the installation shown above.

The H. W. Butterworth & Sons Co., has selected a Maxitorq No. 22 double type as original equipment in their newest No. 657 Laboratory Jigger.

Separator Springs keep "floating discs" free in neutral . . . consequently there's no drag, no abrasion, no heating. They also assure instant, complete disengagement. Assembly, adjustment, and take-apart are manual. Clutches are shipped completely assembled, ready to slip onto a shaft.

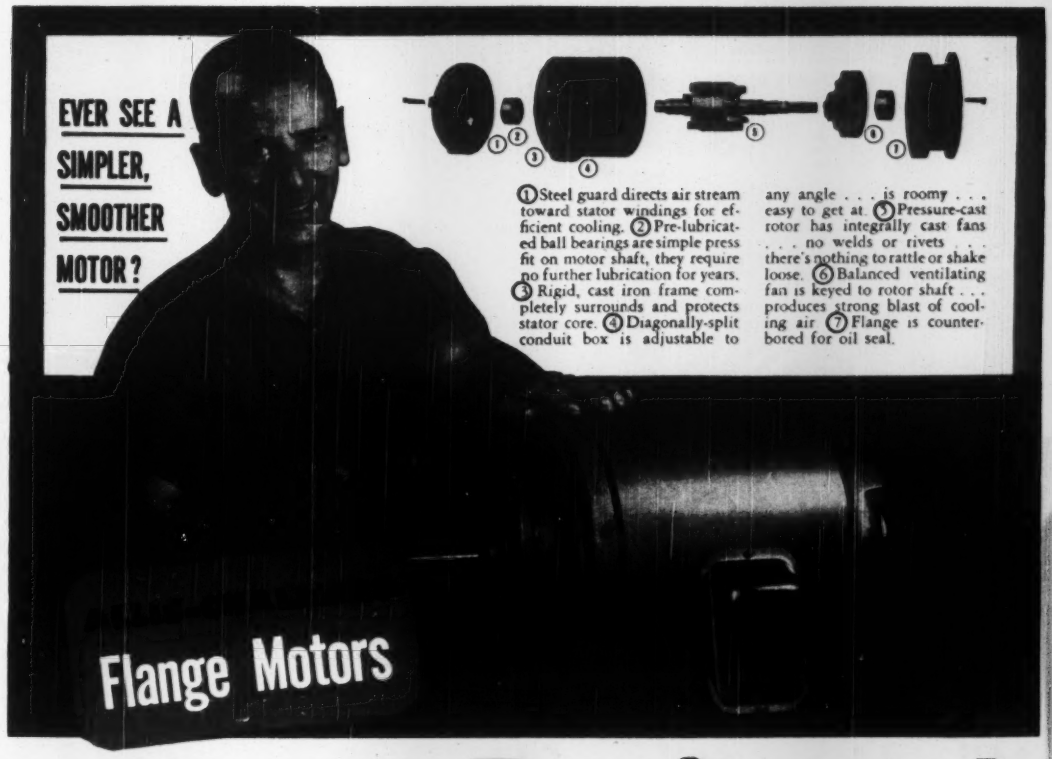
All clutches can be supplied with Pulley Type, Cut-off Coupling, or Ring Type driving cups. Eight sizes from ¼ to 15 H.P. at 100 r.p.m., single or double, wet or dry. Clutches also available with Automatic Overload Release feature.

We'd like to have *you* join our "Good Company" users.

Send for new 1950 Catalog ME3

SCJ80

THE CARLYLE JOHNSON MACHINE COMPANY
MANCHESTER • CONNECTICUT



① Steel guard directs air stream toward stator windings for efficient cooling. ② Pre-lubricated ball bearings are simple press fit on motor shaft, they require no further lubrication for years. ③ Rigid, cast iron frame completely surrounds and protects stator core. ④ Diagonally-split conduit box is adjustable to any angle . . . is roomy . . . easy to get at. ⑤ Pressure-cast rotor has integrally cast fans . . . no welds or rivets . . . there's nothing to rattle or shake loose. ⑥ Balanced ventilating fan is keyed to rotor shaft . . . produces strong blast of cooling air. ⑦ Flange is counterbored for oil seal.

. . . meet Designer's Specifications!

CHOOSE *modern* flange motors that are real space savers. These motors "hug-up" tight against your machines . . . help eliminate problems of motor alignment . . . give your product that streamlined appearance that customers like.

And your customers can expect a *new low* motor maintenance from now on! That's because these *improved* Allis-Chalmers flange motors give them this 4-point motor protection:

1. PRELUBRICATED BEARINGS that need no attention for years.
2. RIGID CAST IRON FRAMES that can take hardest abuse.
3. MULTIPLE DIPPED AND BAKED insulation gives extra protection against heat and moisture.
4. ONE-PIECE PRESSURE CAST ROTOR has no rivets or welds . . . there's nothing to shake loose.

Allis-Chalmers Flange Motors are available in C and D flanges and P Bases, sizes to 150 hp. Mail the coupon for specification sheet containing ratings, dimensions, etc.

Whether you need flange motors or any type of motors, remember Allis-Chalmers! Also matching control for *any* motor.

ALLIS-CHALMERS, 949A SO. 70 ST. MILWAUKEE, WIS.

Please send me:

- ☐ Flange Motor Specification Sheet (5157324)
- ☐ Handy Guide to Electric Motors (5186052)
- ☐ General Purpose Motor Controls (1487132)

Name .....

Title .....

Company .....

Street .....

City ..... State .....

A-7918

ALLIS-CHALMERS

SOLD — APPLIED — BY AUTHORIZED DEALERS, AND DISTRICT OFFICES THROUGHOUT U. S., SERVICED BY CERTIFIED SERVICE SHOPS.

Miles Upon Miles of Underground Cable..

. . . have been lead encased by Robertson Equipment. Many producers of such cable have been specifying and using Robertson Equipment . . . *There must be a reason.*

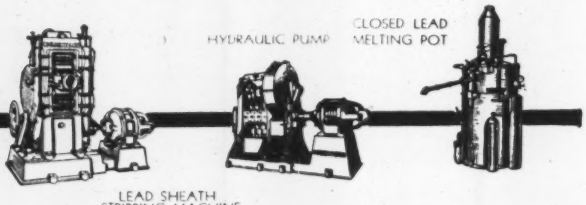
Robertson Products Include: Hydraulic Pumps, Lead Melting Pots and Furnaces, Lead Sheath Stripping Machines, Dies, and High Pressure Hydraulic Equipment *for special uses.* Write for complete data.

JOH. Robertson

191-137 WATER STREET, BROOKLYN 1, NEW YORK

Designers and Builders of all Types of Lead Covering Machinery

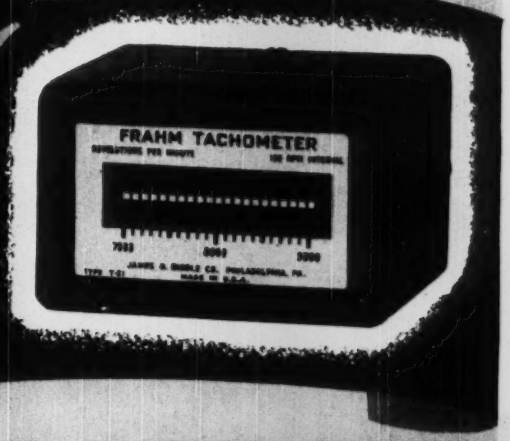
Since 1885



It's New!

the T21, Miniature Frahm Tachometer

. . . measures speeds quickly and accurately simply by touch or permanent mounting



This is the T21 . . . the new, low-cost, *miniature* Frahm Tachometer which offers all the advantages of simplicity, dependability and long life of Frahm Resonant-Reed Instruments. It will measure the speed of a large steam turbine, gyro or centrifuge as simply and easily as that of fractional hp motor-driven equipment. Just touch the casing of the machine or mount the instrument at some convenient location.

The T21 operates on the Frahm Resonant-Reed principle wherein tuned steel reeds respond—by resonance—to the slight vibration of the machine against which the instrument is held or on which it is mounted. That is all there is to it. The instrument has no parts to wear out, needs no maintenance, imposes no load on the machine under test, nor can it be damaged by overspeeding. And, the T21 is available in 11 various ranges to suit your needs. Whether for shop or tool kit use, you'll want this low-cost, precision-made, yet rugged tachometer for your speed measuring problems.

THE T21 MEASURES SPEED

SIMPLY BY TOUCH . . . . . OR BY MOUNTING ON MACHINE

Choose The RPM Range You Need

Catalog No.	Range	Catalog No.	Range
2412	1000 to 1500	2445	4000 to 5000
2418	1500 to 2000	2460	5000 to 7000
2419	1700 to 2200	2461	5200 to 7200
2424	2000 to 3000	2472	7000 to 9000
2436	3000 to 4000	2499	9000 to 12000
2437	3400 to 4400	Special Ranges on Request	

Accessory Prices

MOUNTING BRACKETS	
Cat. No. 2405—60° Mounting Bracket	$3.00
Cat. No. 2406—90° Mounting Bracket	$3.00
CARRYING CASES	
Cat. No. 2407 Fabricoid Case for 1 inst.	$1.50
Cat. No. 2408 Fabricoid Case for 3 insts.	$4.00
Cat. No. 2409 Leather Case for 1 inst.	$4.00
Cat. No. 2410 Leather Case for 3 insts.	$5.50

Send in Your Order Today!

ONLY $27.00* F. O. B. PHILA.

*Discounts in quantity

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments

1316 ARCH STREET, PHILADELPHIA 7, PA.

JAMES G. BIDDLE COMPANY
1316 Arch Street, Phila. 7, Pa.

☐ Send C. O. D.
☐ Check Enclosed

Send me the following Miniature Frahm Tachometers:

Cat. Nos. _____

Brackets (Cat. Nos.) _____

Cases (Cat. Nos.) _____

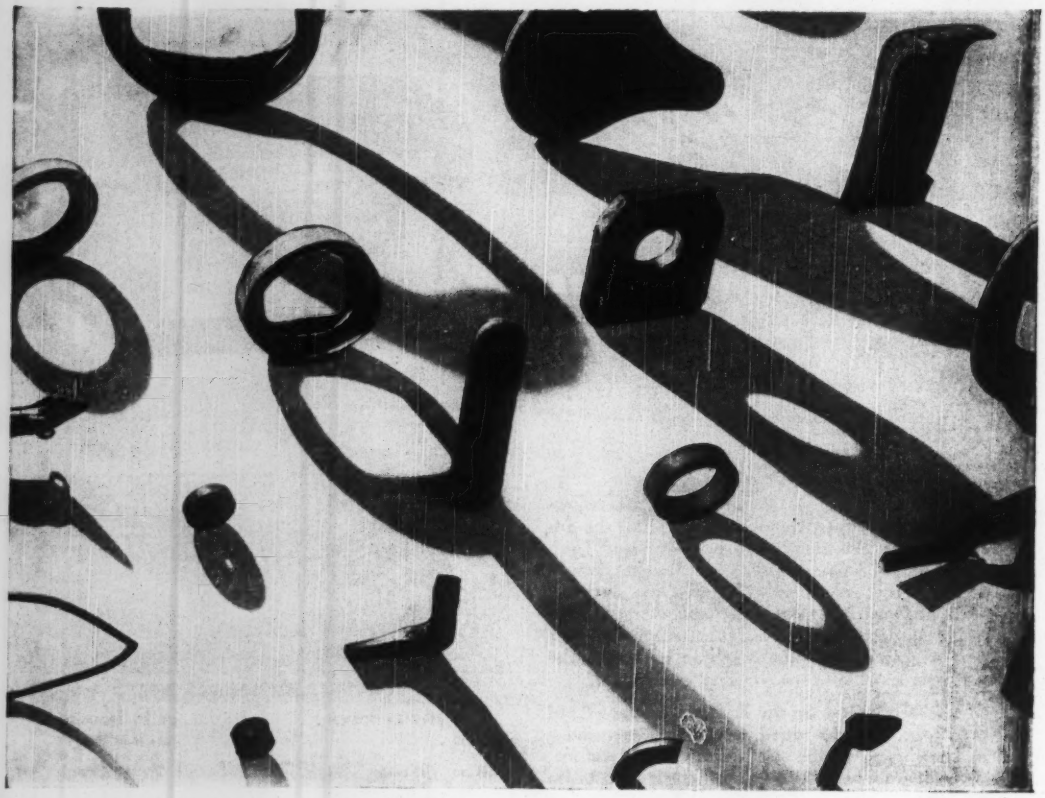
☐ *I should like to know more about the T21. Please mail without obligation your bulletin 31-35 M.*

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



ENGINEERING in cellular rubber that keeps pace with your *imagination*

In some minds Spongex cellular rubber is a vibration pad for huge hydraulic presses, to others it is a powder puff. For other thousands Spongex is of a density and compression range that was especially compounded to do their job best. There seems to be no limit to man's imagination in creating new uses for Spongex.

In serving man's creative mind our laboratory has formulated over 60,000 recipes for cellular rubber. Each applies one or more of the known qualities of Spongex to insulate against shock, vibration, sound, air and temperature.

In every industry there exist problems that Spongex may solve. Whenever your thoughts are on vibration, insulation, cushioning, gasketing, sealing or sound damping, think about Spongex. It can be your biggest help.

Spongex cellular rubber is available in molded shape or die cut form—or in sheets, slabs, strips, cord, tubing, or bonded to metal or fabric.

Write for *Technical Bulletin on Sponge Rubber* today.

The World's Largest Specialists in Cellular Rubber

THE SPONGE RUBBER PRODUCTS COMPANY
301 DERBY PLACE SHELTON, CONNECTICUT

LINK-BELT *Precision Steel* ROLLER CHAIN *GIVES* POSITIVE POWER TRANSMISSION PLUS LONG LIFE

Performance on every type of equipment and in every industry proves the high quality of Link-Belt Precision Steel Roller Chain, incorporating the knowledge and experience of the world's largest manufacturer of chain.

Positive transmission of power, efficient conveying, compactness, wide flexibility of arrangement, ability to absorb shock, are characteristics of roller chain which are enhanced by the precision manufacturing methods and metallurgical control followed in the huge Link-Belt chain plant.

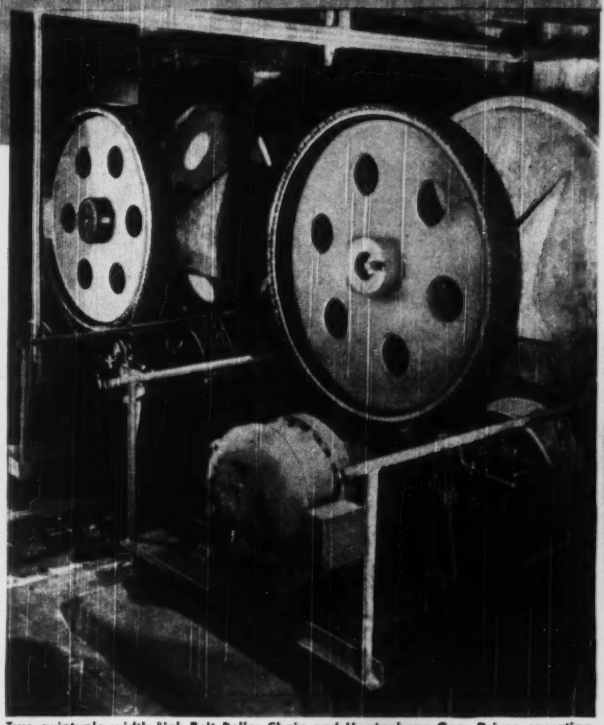
Link-Belt Precision Steel Roller Chain runs slack on long or short centers, minimizing shaft bearing pressure, and operates at highest efficiency, since there is no possibility of slip. A number of shafts, turning in either direction, can be grouped in a single drive. The flexibility of each joint supplies a general cushioning effect, absorbing rather than transmitting shock from one shaft to another.

Link-Belt Precision Steel Roller Chain and sprockets are available immediately, in single or multiple widths, in $\frac{3}{8}$" to 2$\frac{1}{2}$" pitch. Also with various types of attachments as well as the Universal Carrier, Flat-top, double pitch and horizontal plane bend types of chain. Made to manufacturers' (A.S.A.) standards. Send for Data Book No. 1957-A.

LINK-BELT COMPANY

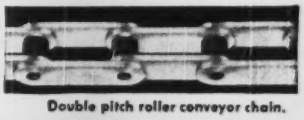
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices, Factory Branch Stores and Distributors in Principal Cities.

11,634-C

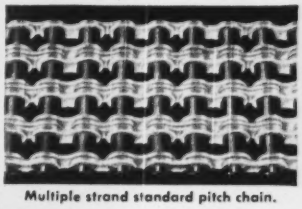


Two quintuple width Link-Belt Roller Chain and Herringbone Gear Drives operating tankage dryers. These drives eliminated noisy, troublesome arrangements of bulky gears and spur pinions.

Single strand standard pitch chain.



Double pitch roller conveyor chain.



Multiple strand standard pitch chain.

Universal Carrier chain, flexes in 2 planes.

Ewart Plant — Link-Belt Company — Indianapolis, Ind.

LINK-BELT

ROLLER CHAINS & SPROCKETS

World's largest makers of Chains for Power Transmission and Conveying

For better damping and easier installation . . .

ONE-CYLINDER DIESEL'S VIBRATION CONTROLLED WITH ISOMODE* MOUNTS

ONAN 2500 watt Diesel Electric Plant, Model 205DSP. Cutaway section shows the Isomode shock mounts.

Isolated on 4 Isomode units, this ONAN Single Cylinder Diesel-Electric Set needs no ton of vibration-absorbing mass at its base!

Single-cylinder Diesels, due to large unbalanced inertia forces, present a tough problem in vibration. In fact, without suitable isolation, such a power plant usually requires a massive foundation to control the destructive vibrations. Faced with this problem, Onan engineers rigorously tested a number of vibration isolators in a search for the right answer.

And they found it, to their complete satisfaction—in Isomode mounts. Not only did these units provide outstanding damping of motion, but they allowed easy installation on the generator set as well! The four Isomode isolators permit this electric plant to be bolted directly to the floor. Moreover, because they're uniformly flexible in all directions, these mounts also reduce strains on engine parts.

This typical case once again demonstrates the advantages of using the mounts with *equal spring rates in all directions*—MB mounts. More and more designers are discovering how they give improved isolation, last longer—and often simplify mounting bracket design and installation. In these units you may find the solution to your own problem, too. Write us. Our engineers will gladly go over your requirements with you.

*Trade Mark Reg. U.S. Pat. Off.

THE ADVANTAGES OF designing with ISOMODE MOUNTS

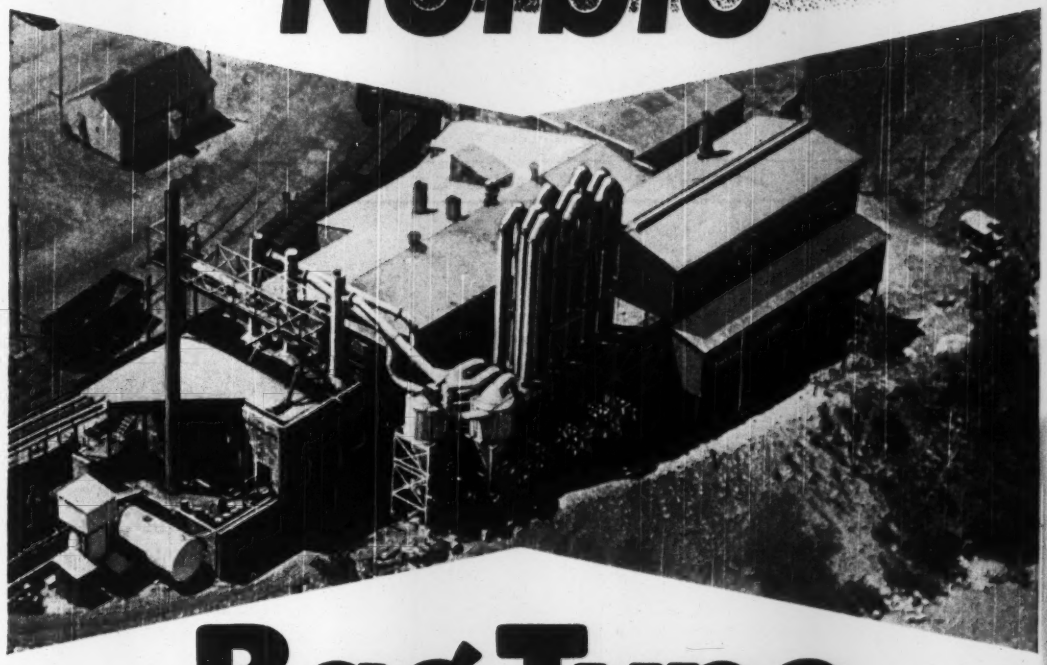
- ✓ *They absorb vibration equally well in all directions* — vertical, as well as troublesome horizontal and rocking motions.
- ✓ *Non-directional* — can be mounted at any angle, in any direction, simplifying design problems.
- ✓ *High load capacity* in compact size — saving space, weight.
- ✓ *Large rubber volume* for softness — yet perfectly stable and self-snubbing.

SEND FOR THIS BULLETIN which gives details on a number of products that can help you with your vibration problems. Write for bulletin No. 410-J4.

THE MB MANUFACTURING COMPANY, INC.
1060 State Street, New Haven 11, Conn.

PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION . . . TO DETECT IT . . . TO REPRODUCE IT

Norblo



Bag Type

DUST AND FUME COLLECTION

78 cylindrical bags, having 936 square feet of free cloth area, are the basic unit of Norblo Automatic Bag Type Dust Collectors. As only one unit is out of operation at a time, and then only for a few seconds per cycle, Norblo operates continuously at full rated capacity. Timing can be changed for adjustment to dust load without shutting down.

Write for Bulletin 164-2 giving complete description, diagrams, dimensions and capacities of Norblo heavy duty automatic bag type dust collectors.

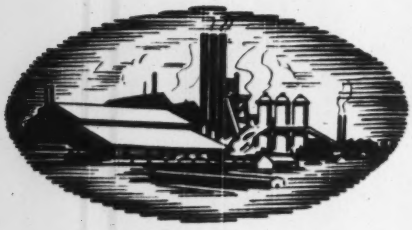
Star Performance in Heavy Duty

1. Continuous operation, easy maintenance; any compartment can be shut down for bag repair, etc., without affecting the others.
2. Upward air flow *inside* bags keeps them always fully distended — allowing free fall of dust for maximum gravity separation.
3. Cyclic cleaning is adjustable for varying dust load instantly and without shutting down the collector — flexibility and efficiency tailored to the job.

THE NORTHERN BLOWER COMPANY

6421 BARBERTON AVENUE • CLEVELAND 2, OHIO

Automatic and Standard Bag Type Fume and Dust Collectors, Norblo Centrifugal and Hydraulic Collectors, Cement Air Cooling Systems, Exhaust Fans



1900 ★ THE MIRACLE OF AMERICA ★ 1950

Freedom and Progress

It's no stretch of the imagination, rather, robust realism to call our past half century a Miracle—U. S. A.

America has set an amazing record of progress in 50 years—but a moment in the history of civilization. A record unequalled by any other political or economic system.

Merely by broad brush strokes, we can all visualize this miracle. Remember the crystal set, the hand-cranked car, the biplane? A far cry from our FM radio, television, hydro-matic drive and supersonic planes.

And here's another phase of the miracle that went hand-in-hand with these and the myriad of intertwined technological advances—ranging from the radio telephone and Bakelite to the X-ray tube and teletype . . . and to atomic energy and its untold potentialities.

- Since 1900 we have increased our supply of machine power 4½ times.
- Since 1900 we have more than doubled the output each of us produces for every hour we work.
- Since 1900 we have increased our annual income from less than $2400 per household to about $4000 (in dollars of the same purchasing power), yet . . .
- Since 1900 we have cut 18 hours from our average work week—equivalent to two present average workdays.

How did we do it? The basic cause for this composite miracle has been the release of human energy through FREEDOM, COMPETITION and OPPORTUNITY. And one of the most important results is the fact that more people are able to enjoy the products of this free energy than in any other system the world has ever known.

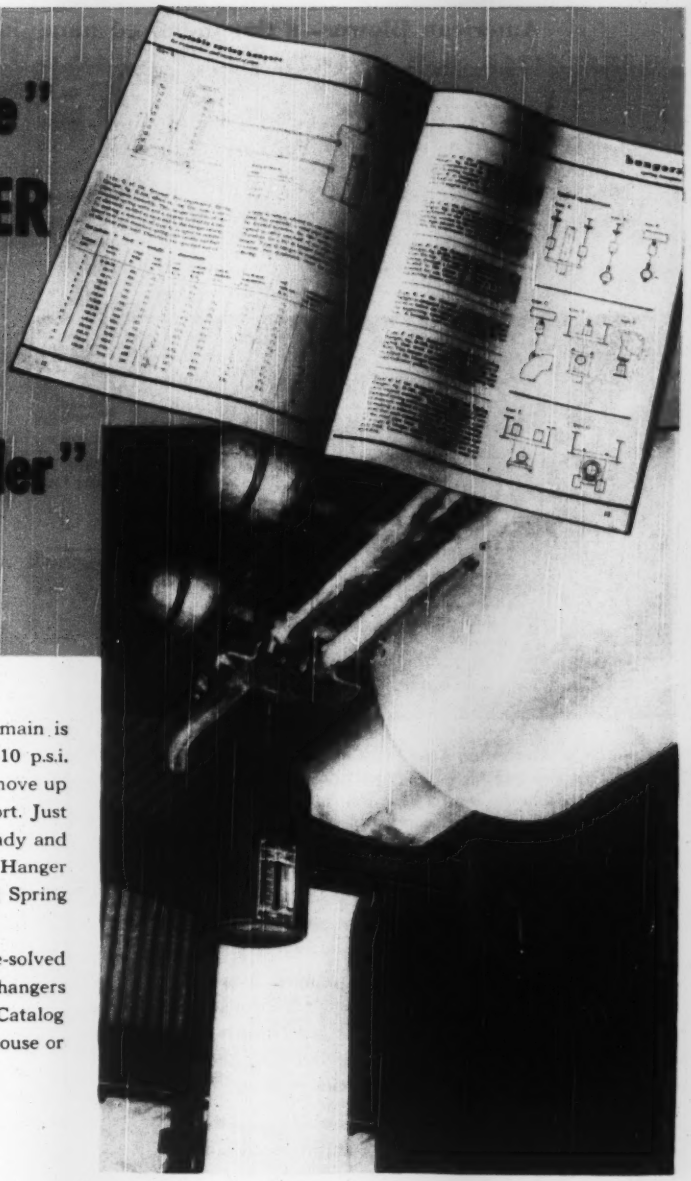
THIS IS THE MIRACLE OF AMERICA . . . it's only beginning to unfold.

A PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL ·

Published in the public interest by:

MECHANICAL ENGINEERING

"Ready-made" PIPE HANGER for a "made-to-order" FIT



Look how closely this 8-inch steam main is tucked up under the roof. And, at 410 p.s.i. and 550° F., this piping was bound to move up and down enough to need flexible support. Just the hanger to fit this situation was ready and waiting right in the Grinnell Pipe Hanger Catalog 10-D . . . the Pre-Engineered Spring Hanger fig. B268, type G.

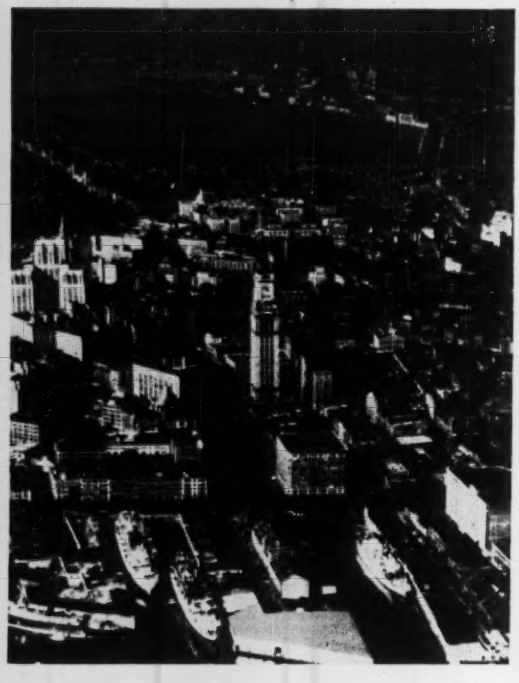
Every pipe suspension problem is pre-solved for you by Grinnell ready-to-install hangers and supports. You can get a copy of Catalog 10-D from your Grinnell branch warehouse or local Grinnell jobber.

100th ANNIVERSARY PIPING

GRINNELL

Grinnell Company, Inc., Providence 1, R. I. Warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

American Blower—a time-honored name in air handling



In Boston, as in other cities, American Blower Air Handling Equipment serves commerce, industry and public utilities. For air handling data in the Boston area, call American Blower —Liberty 2-8427. In other cities, consult your phone book.

Look before you buy. Comparison tests prove the superiority of American Blower Products. There's a big difference in quality, design, quietness, operating costs and efficiency between American Blower and other air handling equipment.

Air is free . . . use it profitably!

WHEN YOU buy American Blower Equipment, you're buying the result of research—research in ventilating, heating, cooling, drying, air conditioning, collecting materials from air and air handling that dates back to the very beginning of the industry.

You're also getting the firsthand knowledge and experience that comes from thousands and thousands of applications in every type of business in every industry.

These are plus values you cannot afford to overlook.

To buyers of air handling equipment, whether it be power plant equipment—mechanical draft fans, fly ash precipitators, Gyrol Fluid Drives for fan control and boiler feed pumps, or air handling equipment for any need—these plus values insure longer, more dependable service and lower operating costs.

Our nearest branch office will give you full data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY

AMERICAN BLOWER

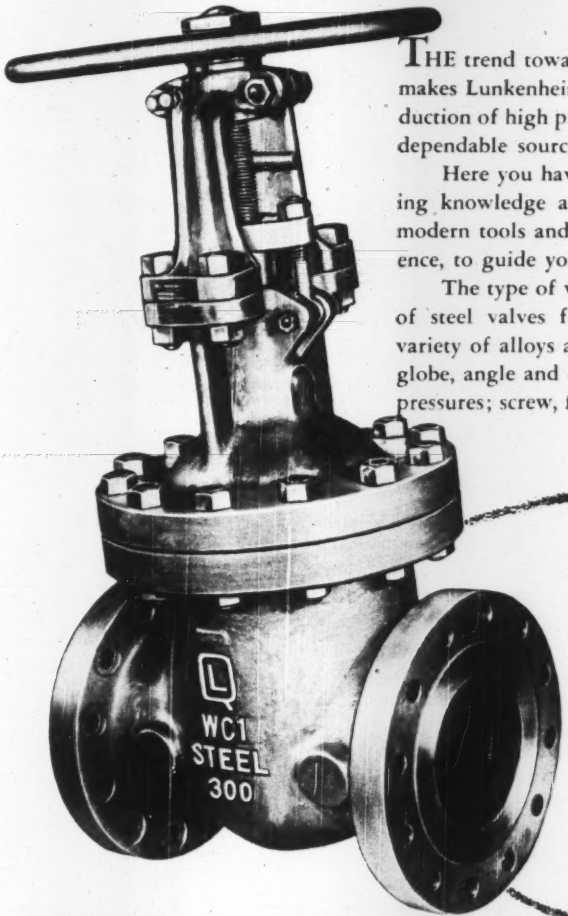
AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

FOR *Steel Valves* YOU CAN'T GO WRONG ON LUNKENHEIMER

This mark on steel valves is your assurance of highest quality



THE trend toward wider use of steel valves for many services makes Lunkenheimer, who pioneered the development and production of high pressure-high temperature designs, a logical and dependable source of supply.

Here you have top metallurgical research, sound engineering knowledge and design, advanced foundry practice, most modern tools and manufacturing equipment, plus wide experience, to guide you in the selection of your requirements.

The type of valve illustrated is only one of a complete line of steel valves for every industrial purpose. Available in a variety of alloys and trims to suit specific applications . . . gate, globe, angle and check patterns, 150 lb. to 2500 lb. and higher pressures; screw, flange or welding ends.

300 lb. CAST STEEL GATE
Fig. 1938-WD6

Body and bonnet are of Carbon Molybdenum Steel to provide for higher pressure-temperature operation than the limits prescribed for carbon steel. Disc and stem are stainless steel, seat rings high tin content nickel alloy developed by Lunkenheimer—a fine-wearing combination for steam up to 850° F., and general service on water, gas or air.

Lunkenheimer design and construction insure all the essentials for satisfactory and low-cost service.

Helpful Service at Your Call . . .

Lunkenheimer representatives and sales engineers will be glad to work with you on any problem of valve installation and usage. And for your immediate maintenance requirements, call your Lunkenheimer Distributor. He is well qualified to take care of your needs.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO, U.S.A.

NEW YORK 13 · CHICAGO 6 · BOSTON 10 · PHILADELPHIA 34

EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.

Leadership Through Achievement

C-E Vertical-Boilers

Modern steam generating equipment can't lower the price of a ton of coal or a barrel of oil, but it *can* produce *more* steam from every ton of coal or every barrel of oil. The modern unit can't lower the cost of a man-hour, but it *can* and *does* operate so reliably that maintenance costs are kept at a minimum.

C-E Vertical-Unit Boilers represent truly modern standards of design. To an exceptional degree they incorporate all the important advances in steam generation made in the past twenty-five years . . . advances that have resulted in substantially increased efficiencies and lower operating costs. At today's high costs of fuel and labor, these gains in operating efficiency may well prove the difference that will make replacement a profitable procedure for you. So whether you are considering the purchase of equipment for replacement or expansion, or for a new plant, a C-E Vertical-Unit Boiler will provide the right answer to your particular situation.

The three units illustrated—and others in the Vertical-Unit line not shown—are collectively designed to serve virtually every industrial requirement from about 10,000 to 300,000 (or more) lb of steam per hour, pressure up to 1,000 psi and steam temperatures to 900 F. The entire Vertical-Unit line offers the advantages of time-tested standards of design coupled with that flexibility of application—fuels, firing methods, operating conditions, etc.—required to meet particular plant needs. We shall be pleased to supply catalogs and any additional information required upon request.

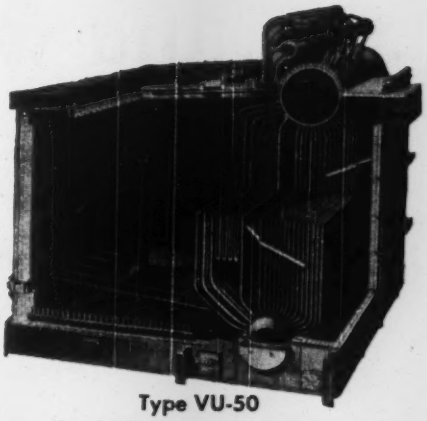
B-371

COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

-Unit

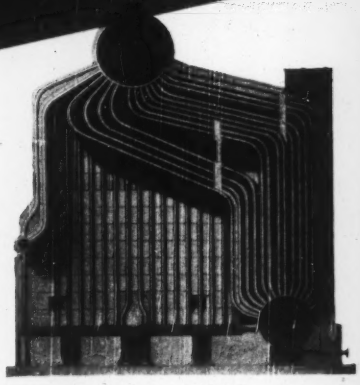
today's best answer to high steam costs



Type VU-50

(for the higher capacity range)

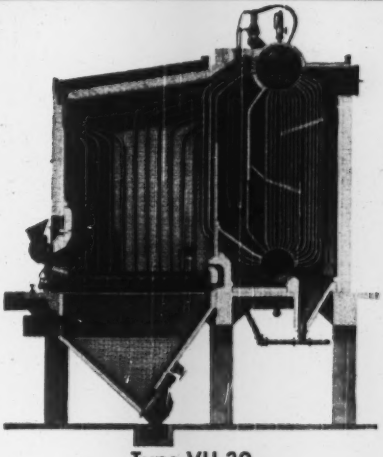
This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 300,000, or more, lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.



Type VU-10

(for the lower capacity range)

This member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 50,000 lb per hr. Firing may be by spreader, underfeed or chain grate stokers, or by oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.



Type VU-30

(for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.

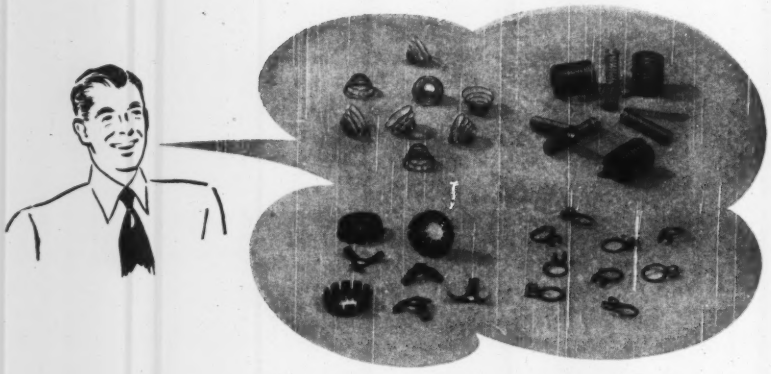
—SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

.....and we

"QUOTE"

"It matters little to the ultimate user of a product whether or not a spring is employed in its proper functioning. But to the manufacturer, the one who is deeply concerned with the quality of his product, the resilient member—the spring—stands out as the very heart of the mechanism."



Your requirements, too!

SMOOTH ACTING

GIBSON-SPRINGS

CLIPS · SMALL STAMPINGS
CLAMPS · WIRE FORMS

The William D. Gibson Co.

DIVISION OF ASSOCIATED SPRING CORP.
1800 CLYBOURN AVE., CHICAGO 14, ILL.

FLEXONIFLEX—The Proven HIGH PRESSURE Expansion Joint!

CMH Flexoniflex Joints answer the question of how to make flexible connections wherever gases or fluids must be conveyed between relatively moveable parts in the *1000 psi working pressure range. CMH *Integral Ring* Flexoniflex Joints represent years of intensive research and development. They are fabricated, by methods originated by CMH, to withstand pressures far in excess of those which previously have been considered safe for expansion joint use. Designs of these joints are made to absorb lateral, axial and radial motion or combinations thereof. Standard sizes range from 5/8" through 6" I.D. Larger sizes are available. Suitable for temperatures from sub-zero to 1400°F.

For specific recommendations, send complete details of your service.

*1000 psi. is a nominal pressure limitation. Flexoniflex units have been designed and manufactured for pressures well in excess of this.

Illustrated is a Flexoniflex unit designed to absorb axial motion. Other designs are available to absorb other types of motion.

CMH
Flexoniflex
EXPANSION JOINTS

CMH—ONE dependable source
for every flexible metal hose requirement

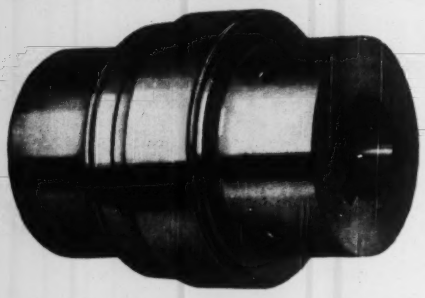
• CMH manufactures all standard types of flexible metal hose, both convoluted and corrugated, in a variety of metals; expansion joints for piping systems; stainless steel and brass bellows; various conduits and special assemblies of these components.

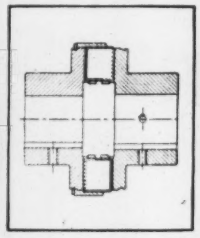
CHICAGO METAL HOSE CORPORATION

Leaders in the Science of Flexonics
1305 S. Third Avenue
MAYWOOD, ILLINOIS
Plants at Maywood, Elgin and Rock Falls, Illinois
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ontario

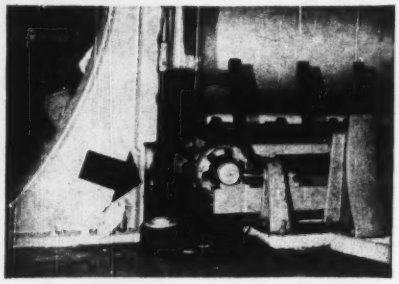
FLEXON . . . . . identifies CMH products which have served industry for more than 48 years

There's a real reason for **NO SHUTDOWNS** *when you equip with* **LOVEJOY L-R Flexible Couplings** *at low cost!*





Lovejoy L-R Type "H" for heavy duty. Pat. and Pats. Pend.



Courtesy of Beloit Iron Works. Arrow indicates one of Lovejoy Couplings used in plant of North Carolina Pulp Co.

- ✓ No metal-to-metal transmission. No metal wear.
- ✓ No need of lubrication—ever.
- ✓ Load carried by tough, resilient, free-floating cushions between metal jaws. Cushions adjust *instantly* for correction for misalignment, vibration, backlash, chatter, etc. Result: even, silken power-flow.
- ✓ Cushings always in sight. Half are idlers right at hand for change when required. No shutdowns for changing.

Also mfrs. Lovejoy Variable Speed Transmissions and Lovejoy Universal Joints.

SEND FOR COMPLETE LOVEJOY CATALOG AND QUICK-FINDING SELECTOR CHARTS FOR YOUR COUPLINGS. Sizes for every duty, and every kind of duty from 1/6 to 2500 h.p. Phone—wire—write

LOVEJOY FLEXIBLE COUPLING CO. 5032 WEST LAKE ST CHICAGO 44, ILLINOIS

New di-acro POWERSHEAR

OFFERS
CONTINUOUS ACTION
plus
VARIABLE SPEED
From 30 to 200 strokes per minute

for high speed
DIE-LESS DUPLICATING

The new Di-Acro POWERSHEAR has remarkable speed and accuracy for the production of small parts and pieces. Consider these points: 1. **CONTINUOUS SHEARING ACTION** — no clutch to engage! Feeding speed determines shearing speed. 2. **VARIABLE SPEED** — cutting cycle quickly set for each shearing operation. 3. **EASE OF OPERATION** — fatigue is reduced, accuracy increases, production soars. 4. **"SINGLE STROKE" SHEARING** — non-repeating safety clutch for jobs not adaptable to continuous shearing.

Any plant doing high speed precision work on smaller parts from any shearable material cannot afford to be without the DI-ACRO POWER-SHEAR. Available in 12" and 24" shearing widths, capacity 16 gauge sheet steel. Also standard model.

See Di-Acro Exhibit Booth 316 — Tool Engineers' Industrial Exposition, Philadelphia, Pa., April 10-14.

Send for 40 page "DIE-LESS DUPLICATING" catalog.

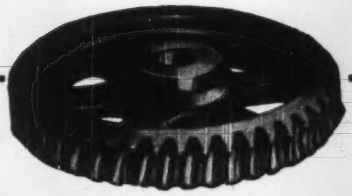
di-acro DIE-LESS DUPLICATING O'NEIL-IRWIN MFG. CO.
308 8th Avenue, LAKE CITY, MINN.

How You Can Lick Your Clutch Problem

Whether your's is a *size, type or capacity* clutch problem, you can save time and effort in solving it by utilizing the quarter century of clutch designing and building experience available in the ROCKFORD engineering department. This service not only offers you a vast fund of power transmission and control know-how, but enables you to examine thousands of successful ROCKFORD CLUTCH applications in hundreds of industries. A letter or phone call will bring prompt assistance.

ROCKFORD Pullmore **CLUTCHES**

ROCKFORD CLUTCH DIVISION
BORG-WARNER
1307 Eighteenth Street, Rockford, Illinois



MANY WORM WHEEL BLANKS for PHILLIE GEAR ARE CAST BY US

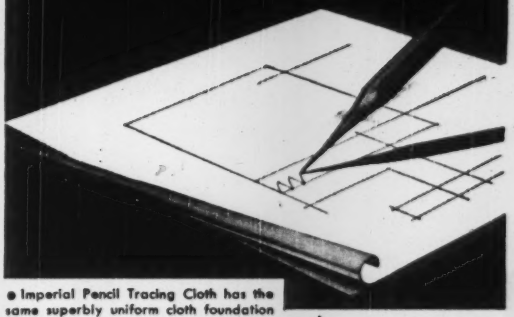
. . . and have been for years; further, we've had the privilege of supplying our HY-TEN-SL Bronze No. 1 for use in the widely known *"LimiTorque" Automatic Valve Operators,* also made by Philadelphia Gear Works.

Should you have a problem involving the use of *Bronze* for Great Strength, Corrosion-resistance or unusual Wear-resistance—get in touch with us . . . no doubt our Engineers can help you.

AMERICAN MANGANESE BRONZE COMPANY

4703 RHAWN ST., HOLMESBURG, PHILADELPHIA 36, PA.
Pittsburgh, Pa. *41 YEARS' EXPERIENCE*

TRACING CLOTH FOR HARD PENCILS



● Imperial Pencil Tracing Cloth has the same superbly uniform cloth foundation and transparency as the world famous Imperial Tracing Cloth. But it is distinguished by its special dull drawing surface, on which hard pencils can be used, giving clean, sharp, opaque, non-smudging lines.

Erasures are made easily, without damage. It gives sharp, contrasting prints of the finest lines. It resists the effects of time and wear, and does not become brittle or opaque.

Imperial Pencil Tracing Cloth is right for ink drawings as well.

IMPERIAL PENCIL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

?

IS YOUR COMPANY LISTED IN THE ·A·S·M·E· MECHANICAL CATALOG AND DIRECTORY

●

USE YOUR 1950 VOLUME TO CHECK IF YOUR FIRM IS LISTED

●

If not listed, write to us upon your Company letterhead, informing us under what product classifications your firm should be listed.

The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Hamilton *Shallow Drawer* Units keep *every* sheet smooth . . . clean . . . accessible!

Here is filing equipment that makes filing easy. Exclusive Tracing Lifter removes all weight from tracings while they are being inserted or removed—permits speedy selection without tearing or wrinkling . . . makes every sheet a top sheet. Any one of the 1,000 drawings you'll store in your *Shallow Drawer* Unit can be referred to or removed and replaced in seconds, without the slightest wear or damage.

In a Hamilton *Shallow Drawer* Unit each of your valuable drawings is stored flat . . . protected from dirt, dust and rodents. Adjustable hood gives exact front-to-back drawer depth desired and never lets sheets curl or creep. Costly redrawing is eliminated.

Finding out more about Hamilton *Shallow Drawer* Units costs nothing, and will save you days and dollars. Just use this handy coupon—

©1950—Hamilton Manufacturing Company

Hamilton Manufacturing Company, Two Rivers 20, Wisconsin

I'd like to know more about Hamilton *Shallow Drawer* Units.

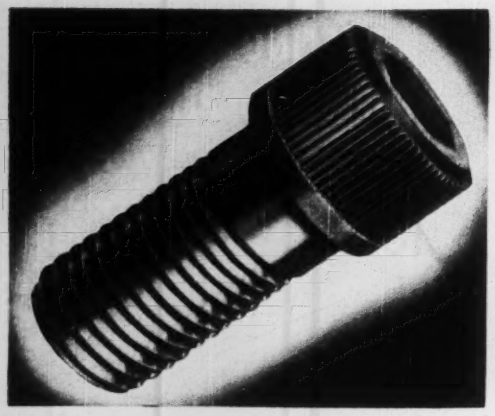
Name _____

Firm _____ Position _____

Address _____

City _____ Zone _____ State _____

HAMILTON MANUFACTURING COMPANY
TWO RIVERS, WISCONSIN



The UNBRAKO Socket Head Cap Screw

The *knurling* on the head of the UNBRAKO Socket Head Cap Screw saves valuable assembly time because the UNBRAKO can be screwed in faster and further with the fingers—the handiest of all wrenches—before a wrench is needed. The slip-proof knurling "gears" the screw to the fingers, even when they are oily or greasy ... this is especially important in the smaller sizes.

So, use Knurled UNBRAKO Socket Head Cap Screws and *save time and money.*

Write for further information.

See us at Space 128, A.S.T.E. Exposition, April 10-14, Convention Hall, Phila.

SOCKET UNBRAKO SCREWS

Knurled Head Socket Cap Screws	*Knurled* Head Stripper Bolts
Flat Head Socket Cap Screws	*Precision-Ground* Dowel Pins
Self-Locking Socket set Screws	*Fully-Formed* Pressure Plugs

SPS STANDARD PRESSED STEEL CO.
JENKINTOWN 20, PENNSYLVANIA

- **INDISPENSABLE . . . for conveying fluids through movable pipe lines or equipment in motion! Complete 360° movement—with no flow restriction. Four styles for standard pipe sizes ¼" to 3".**
- **ECONOMICAL . . . simple in design, Flexo Joints contain no springs, no small or loose parts—assure long wear, extremely low maintenance cost.**
- ***Write for literature on FLEXO JOINT uses.***

FLEXO SUPPLY CO., Inc.

4652 Page Blvd. St. Louis 13, Mo.
In Canada: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 13, Ont.

STOP BASEMENT WALL LEAKS

Smooth-On No. 7 Iron Cement stops your basement wall and floor leaks. You can apply Smooth-On No. 7 with a trowel or stiff brush, to cracks, holes, porous spots or seams in concrete, brick, stone walls or floors. This effective Smooth-On Cement will stay in place, because it expands slightly as it sets. You can also use Smooth-On No. 7 to stop leaks in tanks, cisterns, pools, troughs, fountains, etc. Use it too, to seal openings where piping passes through walls. Sold in 1, 5, 25, and 100 lb. sizes.

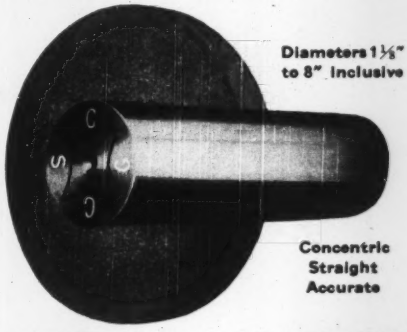
FREE Repair Handbook, 40 pages packed with helpful suggestions for repairs to equipment and piping, in the shop, around the home and car. Also ask for leaflet describing the uses of Smooth-On No. 7. Write today.

SMOOTH-ON MANUFACTURING COMPANY, Dept. 56
570 Communipaw Ave., Jersey City 4, N. J.

Do it with **SMOOTH-ON**
NO. 7 IRON CEMENT

CUMBERLAND GROUND SHAFTS

An Exclusive Product Made by an Exclusive Method



MINIMUM ELASTIC LIMIT	MAXIMUM LENGTHS MANUFACTURED
Cumberland Brand—30,000 lb. per. sq. in.	Year 1845—up to 16 ft.
Potomac Brand—45,000 lb. per sq. in.	Year 1886—up to 25 ft.
Cumsoo Brand—55,000 lb. per sq. in.	Year 1945—up to 70 ft.

They are carefully ground to our standard manufacturing tolerance, plus nothing to minus .002″ on diameters 1-1/8″ to 2-7/16″ inclusive . . . plus nothing to minus .003″ on diameters 2-1/2″ to 8″ inclusive. Closer tolerance can be furnished, if desired.

IMMEDIATE SHAFTS

DISTRIBUTED BY

Baltimore, Maryland—Addison Clarke & Bro.
Boston, Mass.—Hawkridge Brothers Company
Boston, Mass.—Brown-Wales Company
Bridgeport, Conn.—Hunter & Havens, Inc.
Buffalo, New York—Jos. T. Ryerson & Son, Inc.
Charlotte, No. Carolina—Edgcomb Steel Co.
Chicago, Ill.—Central Steel & Wire Co.
Cincinnati, Ohio—Jos. T. Ryerson & Son, Inc.
Cleveland, Ohio—The Bissett Steel Company
Dayton, Ohio—Central Steel & Wire Co.
Detroit, Michigan—Central Steel & Wire Co.
Fort Worth, Texas—C. A. Fischer
Hartford, Conn.—Hunter & Havens, Inc.
Indianapolis, Ind.—Tanner & Company
Jersey City, N. J.—Jos. T. Ryerson & Son, Inc.
Lakeland, Fla.—Mine & Mill Supply Co.
Los Angeles, Calif.—Link-Belt Co., Pacific Div.
Louisville, Ky.—Neill-La Vielle Supply Co.
Martinsburg, W. Va.—W. H. Heiston & Son
Montreal, Can.—Drummond, McCall & Co., Ltd
New Orleans, La.—R. J. Tricon Co.
New York City, N. Y.—Bright Steel Corp.
Oakland, Calif.—Link-Belt Co., Pacific Div.
Philadelphia, Pa.—Charles Bond Company
Philadelphia, Pa.—Horace T. Potts Co.
Pittsburgh, Pa.—McKee-Oliver, Inc.
Portland, Maine—W. L. Blake & Company
Portland, Oregon—Link-Belt Co., Pacific Div.
Providence, R. I.—Congdon & Carpenter Co.
San Francisco, Calif.—Link-Belt Co., Pacific Div.
Seattle, Wash.—Link-Belt Co., Pacific Div.
Spokane, Wash.—Link-Belt Co., Pacific Div.
Toronto, Canada—Drummond, McCall & Co., Ltd
Worcester, Mass.—Pratt & Inman

CUMBERLAND STEEL COMPANY
CUMBERLAND, MARYLAND, U.S.A.
ESTABLISHED 1845 INCORPORATED 1892

with the world's largest selling

VENUS DRAWING PENCILS

- **ACCURATELY GRADED** —in 17 degrees
- **STRONG**—the lead is *Pressure-Proofed*®
- **SMOOTH**—the lead is COLLOIDAL® processed

®Exclusive Venus Patent

They hold their points, give clear, opaque lines for clean, sharp reproduction. No smudge; no ghosts from erasures. They're smooth in action. Lines are uniform in weight and tone. There's the right degree for the tracing paper you prefer. Better prints—*by any process!*

AND FOR RENDERING—PERFECT TONAL VALUES WITH THE SOFTER DEGREES—HB TO 6B

TRY THEM—on your drawing board! Technical Test Kit—FREE!

AMERICAN LEAD PENCIL CO.
Hoboken, New Jersey

LOOK FOR THE GREEN CRACKLED FINISH!

American Lead Pencil Company Dept. No. ME350
Hoboken, New Jersey

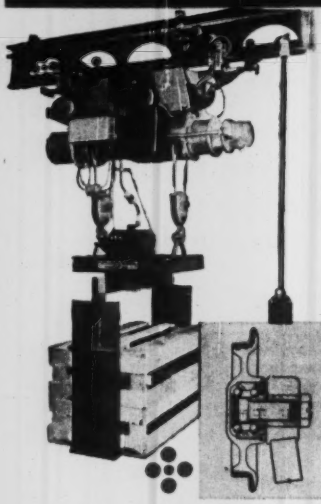
Please send me free *Technical Test Kit* featuring two Venus Drawing Pencils—in these degrees: ( ) ( ).

NAME_____
COMPANY_____
STREET_____
CITY_____ STATE_____

Aetna BEARINGS

CLEVELAND TRAMRAIL SYSTEMS

United Since 1936



Over 30,000 installations . . . handling nearly every conceivable type of material in practically every industry—that's the agressive materials handling record behind Cleveland Tramrail systems.

Aetna double race type wheel bearing No. A-827 as used in Cleveland Tramrail Systems.

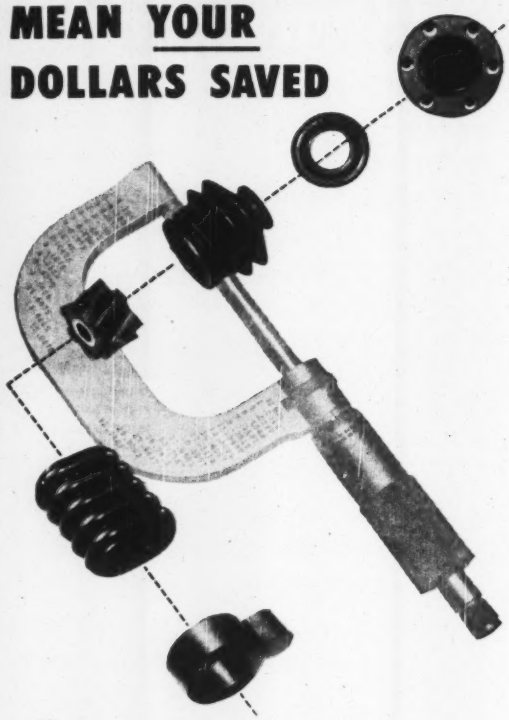
Included among their sturdy components are hard working wheel bearings to meet the high load capacity, precision smoothness and long, trouble-free performance required in this application—bearings which Aetna has proudly supplied for over 14 years.

Greater efficiency is an advantage which comes to any hard working equipment when Aetna bearings lend a hand. For money saving, problem solving counsel on your next bearing application, submit your prints to Aetna. No obligation, of course!

AETNA BALL AND ROLLER BEARING COMPANY
4600 SCHUBERT AVENUE • CHICAGO 39, ILLINOIS

Aetna

CLOSE TOLERANCES *Plus** MEAN YOUR DOLLARS SAVED



WHENEVER your design specifies a natural or synthetic rubber product to close dimensions, remember that LINEAR precision molding will save you money. No matter how tough the job, LINEAR specializes in producing molded parts held to the closest tolerances possible. To you, this micrometer accuracy means:

1. A lower rejection rate eliminating hurried repurchases or a work stoppage due to lack of parts.
2. Easier installation insuring an efficient, smooth-rolling assembly line.
3. Improved performance of your production units drawing wider acceptance and more sales for you.

Whether your requirements are for Precision Molded Diaphragms, Boots, Impeller Seals, "O" Rings, or odd shaped parts—see LINEAR for the accuracy which counts!

**Plus* Laboratory controlled compounds . . .
Engineering service . . .
And an invitation to consult us during the design stage.*

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILADELPHIA 35, PA

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

WESTINGHOUSE

ATOMIC POWER DIVISION

Engineering Opportunity

Position for engineer, having at least a BS degree in electrical or mechanical engineering, and having five to ten years' experience in engineering design work. Preference will be given to applicants who have been personally responsible for the design of electrical or mechanical automatic mechanisms or regulating and control devices. The work is related to the development of electrical, mechanical, and hydraulic control and regulating devices for a nuclear power plant for ship propulsion. Salary open. Location, suburb of Pittsburgh, Pa. For application write:

Manager, Technical Employment

Westinghouse Electric Corporation

306 Fourth Avenue, Pittsburgh 30, Pa.

MECHANICAL ENGINEER

A 65-year-old Midwest manufacturer of a complete line of steam generating equipment has an opening for a graduate mechanical engineer experienced in selling water-tube boilers to customers and contacting consulting engineers. Write immediately giving age, experience, and salary expected.

WM. BROS BOILER & MFG. CO.
Minneapolis 14, Minn.

ENGINEERS WANTED

Atomic Energy
Research Department
of
NORTH AMERICAN
AVIATION, INC.

Engineers (mechanical, electrical, chemical) with either advanced training or experience are desired to do analytical, design, and development work on nuclear power plants, under direct contract with the Reactor Division of the Atomic Energy Commission.

Please reply by letter to:

North American Aviation, Inc.
Atomic Energy Research Dept.
Box No. D-2
12214 South Lakewood Blvd.
Downey, California

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.25 a line. $1.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $20 per inch per insertion. Maximum size: 1 column, 10 inches deep; 2 columns, 5 inches deep. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

for

SENIOR RESEARCH ENGINEERS and PHYSICISTS

Established Electronic and Control Laboratory in the Los Angeles, California area, offers exceptional opportunities for Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

- Microwave Techniques
- Moving Target Indication
- Servomechanisms
- Applied Physics
- Gyroscopic Equipment
- Optical Equipment
- Computers
- Pulse Techniques
- Radar
- Fire Control
- Circuit Analysis
- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

Salaries commensurate with ability, experience and background. Working conditions and opportunities for advancement are excellent. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.

AEROPHYSICS LABORATORY

Box No. H-3

12214 South Lakewood Blvd.
Downey, California

Use a

CLASSIFIED

ADVERTISEMENT

for Quick Results

MECHANICAL ENGINEER

For Mechanical Design and Engineering Studies in connection with Electric Utility work. Should have 15 years' experience in similar work.

***Write to:* Mechanical Engineer, Pennsylvania Power & Light Company, Allentown, Pennsylvania.**

DESIGN ENGINEERS—Civil, Mechanical and Structural. Openings for Qualified men with industrial experience in above lines. Give complete information regarding background, age, references, and salary requirements in first letter. Address CA-3095, care of "Mechanical Engineering."

VALVE DESIGNER—For steadily growing Chicago area company. Prefer man with design experience in the steel valve field. This is a board position. Salary commensurate with ability and experience. Address CA-3104, care of "Mechanical Engineering."

ASSISTANT TO CHIEF ENGINEER—Excellent opportunity, with a progressive company in the Chicago area, for a mechanical engineer experienced in valve design. Send details of qualifications. Address CA-3105, care of "Mechanical Engineering."

WANTED, SEVERAL ENGINEERING GRADUATES—under 35, by large industrial fire prevention organization maintained by national insurance group, for field work involving periodic inspections and special consulting service. Permanent. Address CA-3118, care of "Mechanical Engineering."

ASSISTANT CHIEF ENGINEER—by midwest regulating valve manufacturer. Must be competent designer in valve and control instrument field with thorough application knowledge. $6500 with bonus for outstanding performance. Address CA-3137, care of "Mechanical Engineering."

MANAGER—for expanding Utah power system. Existing facilities include hydro, Diesel, Steam, and transmission being purchased by cooperative federation and substantially enlarged. The man we want must prove ability to handle a $7,000,000 business; engineering, utility or cooperative background desirable. Apply to Southwest Utah Power Federation, Inc., Cedar City, Utah.

HYDRAULIC OR MECHANICAL ENGINEER—Designer with experience in application of hydraulics to machine tools. Position open with well-established New England concern. In reply, please give full details of experience and background. Address CA-3144, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Experienced and capable of taking charge of small engineering department in textile plant of substantial concern. Location midwest. State details education and experience, professional and administrative. Address CA-3145, care of "Mechanical Engineering."

MECHANICAL ENGINEER—college graduate, five or more years' experience in industry for modern, expanding heavy chemical manufacturer in Ohio Valley, West Virginia panhandle. Address CA-3155, care of "Mechanical Engineering."

MECHANICAL AND ELECTRICAL ENGINEER—Excellent opportunity for young man with approximately seven years' experience in design, specifications and supervision of the mechanical and electrical phases of building construction, with particular emphasis on school and institutional work. Full partnership offered for right man in established engineering office. Location: New England. Address CA-3156, care of "Mechanical Engineering."

FIRST CLASS EXECUTIVE—to oversee construction program and manage Missouri generation and transmission cooperative system. Management competence prime factor, with training in utility, engineering or cooperative fields desirable. Apply to L. L. Moran, Savannah, Missouri, Treasurer of N. W. Electric Power Cooperative.

ASSOCIATE PROFESSOR—Progressive land grant college located in the southeast has opening for a man trained and experienced in the field of Machine Design. Should be qualified to teach both graduate and undergraduate courses. Give detailed information in first letter. Address CA-3160, care of "Mechanical Engineering."

POSITIONS WANTED

GRADUATE MECHANICAL ENGINEER excellent educational background, 15 years experience in plant layout, tool and machine design, aluminum-foil specialist, desires permanent position with progressive organization. Will relocate. Address CA-3147, care of "Mechanical Engineering."

INDUSTRIAL ENGINEER—B.S.I.E. Pitt 47. Age 29, single, shop experience, 2½ years drafting and design steam generators. Desire plant engineering or related. Will relocate. Address CA-3146, care of "Mechanical Engineering."

Continued on Page 94

Two Pages of "OPPORTUNITIES" This Month . . . 93-94

POSITIONS WANTED

Continued from Page 93

EXECUTIVE ENGINEER—E.E., Fellow AIEE, member ASME, 30 years' practical experience, Elec., Mech., Heat Transfer and Metallurgical fields. Experience covers Development, Engineering, Patent, Production, Tools, Costs and Sales Domestic and Foreign. Well acquainted in USA, Canada and Mexico, Utilities and Industrials. Address CA-3115, care of "Mechanical Engineering."

MECHANICAL ENGINEERING—Member of A.S.M.E.; Age 48, Married; Registered Graduate Engineer, now employed, desires change for a more responsible position as Mechanical or Assistant Chief Engineer. Twenty years of diversified mechanical experience involving Design, Testing, Patent Developments, Inspection, and Administration Duties. Will travel if necessary. Address CA-3134, care of "Mechanical Engineering."

May I help you plan and administer your preventive maintenance program, supervise your expansion projects, or assist with your production problems? Graduate Engineer, broad experience, seeks responsible position as assistant to or on staff of top management official. Address CA-3138, care of "Mechanical Engineering."

MECHANICAL ENGINEERING GRADUATE—with one year's diversified experience in research, testing, development and design. Special interest in design of mechanisms. Single, 23 years old. Top 25% of class. Address CA-3142, care of "Mechanical Engineering."

SALES-ENGINEERING-MANAGEMENT—Graduate Mechanical Engineer with Management and Marketing training; 4 years' Sales and Engineering Representative; 2 years' Manufacturing and Shop experience; Ex-Naval Officer; Age 31; Prefer California or South. Address CA-3148, care of "Mechanical Engineering."

MECHANICAL ENGINEER—B.S. Carnegie Tech., Member ASME, P. E. license Ohio, age 38, 15 years' experience Power and Fuel, Structural Design and Surveying in Steel Plant. Mechanical and Structural Administration on Steam Power Plants. Desires position as Power Plant Project Engineer, New York area. Address CA-3150, care of "Mechanical Engineering."

MECHANICAL ENGINEER—BSME—ASME. Age 27. One and one-half years' Product Design, Development and Test plus two years' machine shop experience. Desires job with promising future, preferably in small midwestern town. Address CA-3151, care of "Mechanical Engineering."

A proven, aggressive, personable TEAM of TWO graduate engineers desire position requiring ingenuity, inventiveness, executive ability and salesmanship. Their combined qualifications represent a distinctive addition to any company. Resumés upon request. Address CA-3152, care of "Mechanical Engineering."

MECHANICAL ENGINEER—3 years' experience in research, development and test with aero., thermo., fluid dynamics, mechanical test, SR-4 strain gages; a Masters degree in February; demonstrated ability to produce under difficult conditions; intelligent ideas, imagination and initiative; desires a challenging position with a future. Address CA-3153, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Graduate of recognized school, registered, age 35; 5 years' plant engineer in charge of operating, maintenance and plant expansion; 4 years' equipment design and plant layout; total 13 years' industrial experience in engineering. Address CA-3158, care of "Mechanical Engineering."

UNIVERSITY OR COLLEGE POSITION—of professorial rank wanted by Ph.D. Candidate with both industrial and teaching experience in Applied Mechanics. Publications, qualifications and references sent in reply to details of position available. Address CA-3159, care of "Mechanical Engineering."

REPRESENTATIVES AVAILABLE

SELLING OPPORTUNITY WANTED—New York sales organization with six sales engineers needs a superior instantaneous steam water heater or other heat exchanger for all or part of Southern and Central New York State and New Jersey. Now selling steam traps, control valves, etc., to industrials, utilities and institutions. Address CA-3143, care of "Mechanical Engineering."

It will pay you to watch the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

BUSINESS OPPORTUNITIES

HOLDER OF RECENTLY ISSUED PATENT—on simplified, positive displacement, valveless pump desires to sell or license same. Suitable for use as liquid pump, refrigerant compressor, engine, etc. W. F. Crenshaw, 232 St. Joseph St., Lafayette, La.

BUSINESS FOR SALE

MECHANICAL WORKSHOP—fully equipped for precision model-making with following; excellent downtown Manhattan location for immediate sale due to death of owner. Address CA-3154, care of "Mechanical Engineering."

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

EXECUTIVES, ENGINEERS, DESIGNERS, SPECIALISTS—Our staff—technical graduates—serving both employer and applicant 20 years—No fee until placed—Bradley Placement Service, 555 Leader Building—Cleveland 14, Ohio.

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection, communicate with the undersigned. We offer the original personal employment service (40 years' recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby Inc., 115 Dun Bldg., Buffalo, N. Y.

SALARIED PERSONNEL $3,000—$25,000

This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

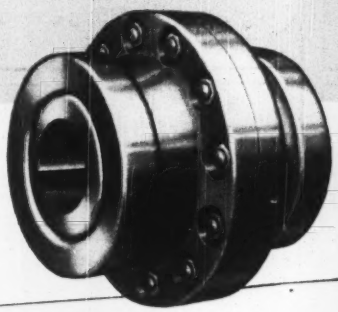
JIRA THAYER JENNINGS
Dept. J, 241 Orange Street, New Haven, Conn.

REPRESENTATIVES AVAILABLE
REPRESENTATION WANTED
BUSINESS OPPORTUNITIES
MANUFACTURING FACILITIES
EQUIPMENT FOR SALE
EQUIPMENT WANTED
HELP WANTED
POSITIONS WANTED
EMPLOYMENT AGENCIES AND SERVICE BUREAUS

If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—use a classified advertisement in MECHANICAL ENGINEERING for quick results.

GOT A COUPLING PROBLEM?

SHEAR PIN?
FLOATING SHAFT?
LOW SPEED?
CUT OUT?
HEAVY DUTY?
REVERSING?
HIGH SPEED?
LIGHT DUTY?



Here's how KOPPERS Engineers *Eliminate Guesswork* when you buy couplings!

These FAST'S COUPLING *Services save you money!*

UNSURPASSED ENGINEERING . . . Koppers' engineers are acknowledged the best in the industry. Their practical knowledge, backed with 30 years' coupling experience, is at your service!

IMMEDIATE DELIVERY . . . All standard types and sizes are available for immediate delivery from "on hand" stocks. In case of emergency, just wire factory for special rush delivery!

LOWEST COST PER YEAR . . . Fast's Couplings will outlast equipment they connect if properly maintained. Their cost may be spread out over 25 years or more, offering you lowest coupling cost per year!

No matter what size couplings you need—whatever the service—*see Koppers first!* Because only Koppers offers you Fast's Couplings, *proved* the best insurance for coupling problems you can buy! For 30 years, Fast's have been industry's standard for *low-cost, trouble-free* coupling operation.

When you specify Fast's you get the benefit of Koppers Engineering service, acknowledged finest available. Koppers engineers, backed with *30 years* of Fast's Coupling experience, study your problem. Then show you *which* Fast's Coupling you need (and more important) *why you need it!*

Take advantage of Koppers long-term coupling experience. Buy Fast's Couplings and get Koppers *valuable* Engineering Service—a service you cannot buy, but which Koppers offers without obligation. The Fast's Catalog contains full details. Mail coupon for your copy today!

KOPPERS **FAST'S**
THE ORIGINAL GEAR-TYPE
Couplings

SEND FOR FREE CATALOG

KOPPERS CO., INC., *Fast's Coupling Dept.,*
253 Scott St., Baltimore 3, Md.

Please send me a copy of Fast's Catalog relative to.....
.....(type of industry).

Name.....
Company.....
Address.....
City.....Zone.....State.....

RATES One Inch Card Announcements inserted at rate of $15.00 per issue, $12.00 per issue on yearly contract.

ENGINEERING SERVICE

Manufacturers of Equipment Not Included

BLACK & VEATCH
CONSULTING ENGINEERS
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction
Investigations, Valuation and Rates
4706 Broadway — Kansas City 2, Missouri

EHRCO DIE CASTING SERVICE
Die Casting Consultation
Equipment — Installation
Die and Product Design
John R. Ehrbar, Pres.
303 Main Street, Stamford, Connecticut
Telephone 3-2308

WELD TESTING
Qualification of Operators—Supervision
Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

BROWN ENGINEERING COMPANY
Consulting Engineers
Power Plants, Substations, Transmission,
Water Supply, Sewage Disposal, Rates
K. P. Building — Des Moines 9, Iowa

C. M. HATHAWAY
CONSULTING ENGINEER
Project Engineering, Product Development,
Production Designs, Laboratory and Shop
Facilities for Research, Model Work,
and Pilot Manufacturing
1315 S. Clarkson Street — Denver 10, Colorado

Consult **Z. H. POLACHEK**
Reg. Patent Attorney
1234 Broadway
(at 31st St.) New York 1, N. Y.
Phone LO 5-3088

M. BUCHSBAUM
DESIGN CONSULTANTS, INC.
Research and Development
Aerodynamics—Structures—Product Design
Electronic Instrumentation
Suite 1017, 521 Fifth Ave., New York 17, N. Y.

GEORGE H. KENDALL
Consulting Mechanical Engineer
Cost Reduction Studies: Process or Product.
Redesign Existing Products for Greater Profit
Trouble Shooting Production, Design, Cost Problems.
Specialist Automatic Machinery, Processes, Controls.
New Developments, Patent Studies, Investigations.
New Products & Process Engineering Studies.
P. O. Box 72 (Est. 1923) Tel. Darien 5-1504
Noroton Heights — Darien, Connecticut

SANDERSON & PORTER
ENGINEERS AND CONSTRUCTORS
New York • San Francisco • Chicago • Los Angeles

THE CARLSON COMPANY
Spring Design Specialists
Mechanical Product Development
277 Broadway — New York 7, N. Y.
Phone Barclay 7-2552

LANCASTER, ALLWINE & ROMMEL
Registered Patent Attorneys
Patent Practice before U. S. Patent Office, Validity and Infringement Investigations and Opinions. Booklet and form "Evidence of Conception" forwarded upon request.
Suite 479, 815-15th St., N. W., Washington 5, D. C.

Power Plants, Structures,
Transmission Systems
Design, Supervision, Inspection
Appraisals, Reports
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

SPECTROGRAPHIC ANALYSES
Qualitative and Quantitative Since 1936
Micro and Semimicro analyses of metallics; conventional and metallurgical analyses, metallography, metal failures investigated, heat treating consultants, photomicrographs, Jominy Hardenability, physical tests.
W. B. COLEMAN & CO.
9th St. & Rising Sun Ave. — Philadelphia 40, Pa.

FRANK LEDERMANN
Registered Patent Attorney
154 Nassau St., New York 7, N. Y.
Telephone Beekman 3-2936

STANLEY ENGINEERING COMPANY
CONSULTING ENGINEERS
Power Plants
Steam - Diesel - Hydro
Design - Construction - Test - Valuation
Surveys
Hershey Building — Muscatine, Iowa

- Engineering Consultants
- Mechanical & Electro - Mechanical Design & Development
- Model Work
- Pilot Manufacturing
- Special Instruments

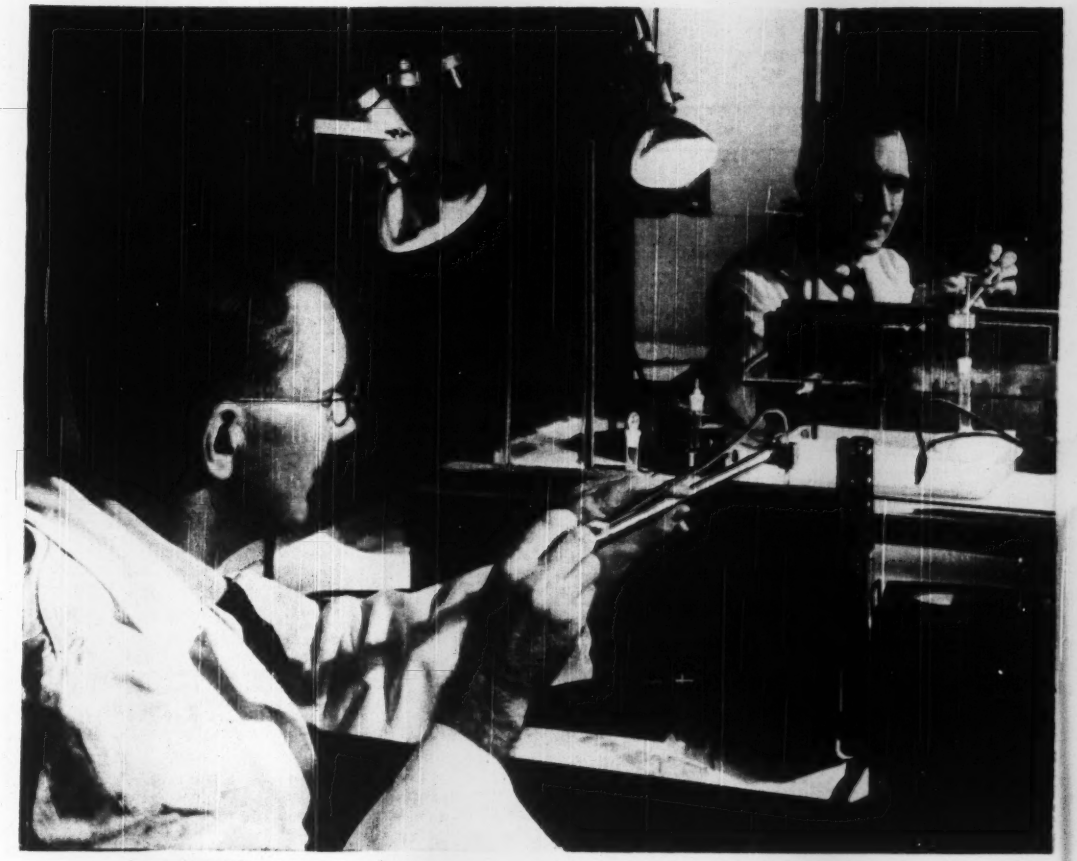
CSI **CUSTOM SCIENTIFIC INSTRUMENTS, INC.**
341 343 Devon Street Arlington, New Jersey

Industrial Power—Surveys & Design
MYERS & ADDINGTON
Consulting Engineers
21 East 40th Street, New York 16, N. Y.
Murray Hill 6-4630

ST & CO. INC.
DESIGNING ENGINEERING
Machines • Products • Plants
Processes • Production • X-Ray
SAM TOUR & CO., INC.
44 TRINITY PL., N.Y. 6, N.Y.

MPB makes more than 50 types and sizes of miniature ball bearings
BEARINGS, Ball, miniature. Standard and Special for application in precision mechanisms to minimize friction and wear. High load capacity in minimum space. Light in weight. Specify MPB for shock loads, continuous operation, extreme temperature ranges and delicate responsiveness. Special designs and complete engineering service for your application. Write for catalog M.
MPB
MINIATURE Precision BEARINGS
INCORPORATED
KEENE, NEW HAMPSHIRE, U.S.A.

EXTRA STRENGTH
for HEAVY DUTY
KEWANEE
• More than 80 years of boilermaking is back of every Kewanee. This Heavy Duty type has all the characteristics which make firebox boilers ideal for high pressure.
10 to 304 H. P.
100, 125 and 150 lbs. W. P.
for firing any fuel
Built of sturdy steel plate reinforced with extra stout stays and braces, they have that known strength which means long life.
For 6" Scale with pipe diameter markings WRITE Dept.
KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS



IT'S DONE WITH MIRRORS!

Protected by a wall of lead bricks and using a mirror to guide his instruments, this Bell Laboratories scientist is preparing a solution of a radioactive isotope, for use as a tracer to study materials for your telephone system.

Bombardment by neutrons turns some atoms of many chemical elements into their "radioactive isotopes"; these are unstable and give off radiation which can be detected by a Geiger counter. Chemically a "radioactive isotope" behaves exactly like the original element. Mix the two in a solution or an alloy and they will stay together; when the Geiger counter shows up an isotope, its inactive brother will be there too. Minute amounts beyond the reach of ordinary chemical methods can be detected — often as little as one part in a billion.

The method is used to study the effect of composition on the performance of newly developed germanium transistors — tiny amplifiers which may one day perform many functions which now require vacuum tubes.

It enables Bell scientists to observe the behavior of microscopic impurities which affect the emission of electrons from vacuum tube cathodes. It is of great help in observing wear on relay contacts. And it may develop into a useful tool for measuring the distribution and penetration of preservatives in wood.

Thus, one of science's newest techniques is adopted by Bell Laboratories to make your telephone serve you better today and better still tomorrow.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Index To Advertisers

*Aetna Ball & Roller Bearing Co. 92
*Air Preheater Corp. 17
*Aldrich Pump Co. 29
*Allis-Chalmers Mfg. Co. 73
*American Blower Corp. 82
American Lead Pencil Co. 91
*American Manganese Bronze Co. 89
*American Pulverizer Co. 42
ASME Publications 64
American Steel Foundries, Elmes Engineering Div. 59
*Armstrong Machine Works 3rd Cover
Aurora Pump Co. 58

*Bailey Meter Co. 2nd Cover
*Barco Mfg. Co. 6
*Barnes, Wallace, Co., Div. Assoc. Spring Corp. 2
Bell Telephone Laboratories 97
Biddle, James G., Co. 75
Brush Development Co. 25
*Buffalo Forge Co. 18
Bundy Tubing Co. 66, 67

Carrier Corp. 12
*Chicago Metal Hose Corp. 87
Clarage Fan Co. 100
Cleveland Worm & Gear Co. 37
Climax Molybdenum Co. 46
*Combustion Engineering-Superheater (Inc.) 84, 85
Cone-Drive Gears Div., Michigan Tool Co. 60
Cumberland Steel Co. 91
Cuno Engineering Corp. 3

*DeLaval Steam Turbine Co. 10, 56
Diamond Chain Co. (Inc.) 19
DuMont, Allen B., Labs. 43

Eagle Pencil Co. 27
Eastman Kodak Co. 71, 99

Faber, Eberhard, Pencil Co. 51
Flexo Supply Co. 90
*Foote Bros. Gear & Machine Corp. 7
*Foster Wheeler Corp. 20, 21
*Foxboro Co. 30

*Gibson, Wm. D., Co., Div. Assoc. Spring Corp. 86
*Gifford-Wood Co. 62
Graphite Metallizing Corp. 41
*Grinnell Co. 81

Haering, D. W. & Co. 52
*Hamilton Mfg. Co. 89

*** The asterisk indicates that firm also has product catalog in the 1950 A.S.M.E. Mechanical Catalog and Directory**

The Only Reference Annual Covering the Mechanical Engineering Field with a Unique Combination of Complete Equipment Directory and Manufacturers' Catalogs Up-to-date 20-page Insert Catalog of A. S. M. E. Publications is included.

Published Annually By
The American Society of Mechanical Engineers
29 West 39th St., New York 18, N. Y.

Hathaway Instrument Co. 58
Helicoid Gage Div. American Chain & Cable 55
Howell Electric Motors Co. 63

Imperial Tracing Cloth 89
International Nickel Co. 32
Irving Subway Grating Co. 42

Jenkins Bros. 38
Johnson, Carlyle, Machine Co. 72

*Kewanee Boiler Corp. 96
*Koppers Co., Fast's Coupling Dept. 95

Linear (Inc.) 92
*Link-Belt Co. 77
Lovejoy Flexible Coupling Co. 88
Lukens Steel Co. 24
Lunkenheimer Co. 83

MB Mfg. Co. 78
Mercoid Corp. 42
*Miniature Precision Bearings (Inc.) 96

*National Airoil Burner Co. 46
National Power Show 68
New Departure, Div. General Motors Corp. 1
Nice Ball Bearing Co. 69
Northern Blower Co. 79

*Oilgear Co. 31
O'Neil-Irwin Mfg. Co. 88

Pacific Pumps (Inc.) 5
*Pangborn Corp. 57
Panoramic Radio Products (Inc.) 53
*Peabody Engineering Corp. 54
Petro-Chem Development Co. 41
Philadelphia Gear Works 14
Physicists Research Co. 40
*Prat-Daniel Corp. 4

*R-S Products Corp. 28
Revere Copper & Brass (Inc.) 26
Robbins & Myers, Motor Div. 9
*Robertson, John Co. 74
Rockford Clutch Div. of Borg-Warner Corp. 88
*Roots-Connersville Blower Corp. 35

*Sarco Co. 8
*Schutte & Koerting Co. 13
Smooth-On Mfg. Co. 90
Sponge Rubber Products Co. 76
Standard Pressed Steel Co. 90
*Standard Stoker Co. 48
Stuart, D. A., Oil Co. 56

*Taylor Forge & Pipe Works 65
*Taylor Instrument Cos. 70
*Terry Steam Turbine Co. 16
Thomas Flexible Coupling Co. 53
*Timken Roller Bearing Co. 4th Cover
*Tube Turns (Inc.) 44, 45

United Screw & Bolt Corp. 50

Vickers (Inc.) 23
*Vogt, Henry, Machine Co. 61

Walworth Co. 22
White, S.S., Industrial Div., S.S. White Dental Mfg. Co. 47
*Wickes Boiler Co. Div. of Wickes Corp. 11
*Wing, L. J., Mfg. Co. 49

*Yarnall-Waring Co. 33

*Zurn, J. A., Mfg. Co. 15

ENGINEERING SERVICE . . . Page 96

Black & Veatch
Brown Engineering Co.
Buchsbaum, M., Design Consultants (Inc.)
Carlson Co.
Coleman, W. B. & Co.
Custom Scientific Instruments, Inc.
Ehrco Die Casting Service
Hathaway, C. M.
Kendall, George H.
Lancaster, Allwine & Rommel
Ledermann, Frank
Myers & Addington
National Weld Testing Bureau
Polachek, Z. H.
Sanderson & Porter
Sargent & Lundy
Stanley Engineering Co.
Tour, Sam & Co.

Advertisers in Previous 1950 issues but not in this issue

All American Tool & Mfg. Co.
Allis, Louis, Co.
*American Felt Co.
Amplex Mfg. Co., Div. of Chrysler Corp.
Arkwright Finishing Co.
Automotive & Aircraft Div., American Chain & Cable

*Babcock & Wilcox Co.
Baldwin-Duckworth Div. of Chain Belt Co.
*Barnes-Gibson-Raymond, Div. Assoc. Spring Corp.
Briggs & Stratton Corp.
Brown & Sharpe Mfg. Co.
*Brownell Co.

Cassell, John R. Co.
Central Scientific Co.
Chace, W. M., Co.
Chain Belt Co.
Chikson Co.
Clark Equipment Co., Industrial Truck Div.
*Cochrane Corp.

*Detroit Stoker Co.
Dowell (Inc.)
*Downingtown Iron Works Drop Forging Association

Eagle Gear & Machine Co.
Economy Pumps (Inc.)
Div. Hamilton-Thomas Corp.
Edwards Valves (Inc.) Sub. of Rockwell Mfg. Co.
*Engineer Co.
*Erie City Iron Works

*Fafnir Bearing Co.
*Farrel-Birmingham Co.
Farval Corp.
*Garlock Packing Co.
Gear Specialties
*General Electric Co.
General Radio Co.
*Goulds Pumps (Inc.)

Hamilton-Thomas Corp.
Hilliard Corp.
Hyatt Bearings Div. General Motors Corp.
Hydropress (Inc.)

*James, D. O., Gear Mfg. Co.
*Johns-Manville
*Jones, W. A., Foundry & Machine Co.

Kay Electric Co.
Kellogg, M. W., Co.
*Kinney Mfg. Co.
Klipfel Valves (Inc.) Div. Hamilton-Thomas Corp.
Ledeen Mfg. Co.
Div. Engineering Products Co.
Leeds & Northrup Co.
*Liquidometer Corp.
Lubrisdate Div. Fiske Bros. Refining Co.

*Marlin-Rockwell Corp.
*Mears-Kane-Offeldt (Inc.)
Midwest Piping & Supply Co.
Morse Chain Co.

New Hampshire Ball Bearings
Niagara Blower Co.
Nordstrom Valve Div. of Rockwell Mfg. Co.

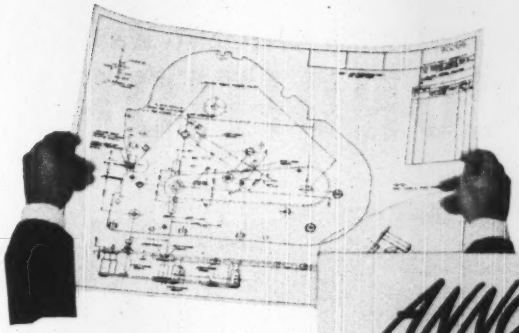
Ozalid Div. of General Aniline & Film Corp.
Permutit Co.
Posey Iron Works (Inc.)
Powers Regulator Co.

*Republic Flow Meters Co.
Research Corp.
Rhoads, J. E. & Sons
Ric-Wil Co.

*SKF Industries (Inc.)
Smith, Winfield H., Corp.
U. S. Electrical Motors (Inc.
*Voss, J. H. H., Co.

*Westinghouse Electric Corp.
Wisconsin Motor Corp.
Wolverine Tube Div., Calumet & Hecla Consolidated Copper Co.
Woods, T. B., Sons Co.

Kodak
TRADE-MARK

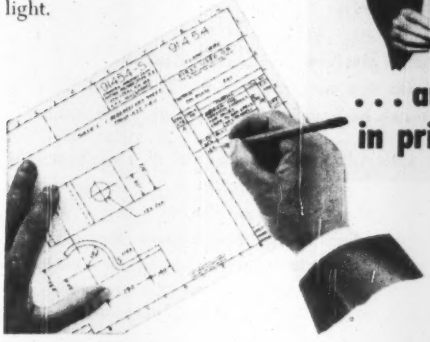


ANNOUNCING
Kodagraph Autopositive Film

1. It gives you faster printing intermediates. Now you can speed up quantity print production . . . save time and money . . . with new Kodagraph Autopositive Film! What's more, you, or your local blueprinter, can expose this amazing reproduction material in high-intensity blueprint or direct-process machines . . . or in a vacuum frame; develop it in standard photographic solutions. You get positive intermediates directly . . . and the job can be done quickly, economically . . . under ordinary light.

2. It holds detail—amazingly. Kodagraph Autopositive Film combines a high-contrast photographic emulsion and famous Kodak safety film base. It catches the finest line – keeps close lines from "filling in." Think what an aid this new intermediate material will be in producing print-making "masters" from difficult originals . . . how it can save you many thousands of dollars in redrafting costs—while assuring final prints of highest quality!

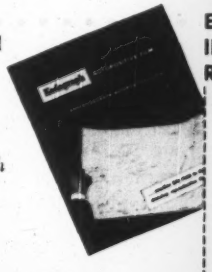
. . . and 4 new advantages in print production for you



3. It simplifies revision, reference. Both sides of Kodagraph Autopositive Film are matte-surfaced . . . can be written on with pencil or pen. And since the base is highly translucent, details can be read from either side without use of an illuminator.

4. It even reproduces illustrations and text on opaque stock—giving you sharp, fast-printing "masters" which will produce sparkling direct-process prints. An economical short cut you'll appreciate in preparing data sheets, instruction manuals, and parts lists.

Mail coupon today for this free illustrated booklet giving all the facts on Kodagraph Autopositive Film—*the latest addition to the famous Kodagraph line of reproduction materials.*



EASTMAN KODAK COMPANY
INDUSTRIAL PHOTOGRAPHIC DIVISION 16
ROCHESTER 4, N. Y.

Gentlemen: Please send a copy of your folder on Kodagraph Autopositive Film.

Name _____ Position _____
(please print)

Company _____ Street _____

City _____ State _____

HERE'S ONE OF THE MOST EFFICIENT WAYS TO AIR CONDITION!

*Units can be also furnished for heating only, or cooling only — very flexible equipment. Every Multitherm is factory tested for performance.

MULTITHERMS—WHOLE "WORKS" IN ONE ASSEMBLY . . . BUILT FOR ALL SORTS OF INDUSTRIAL AND COMMERCIAL APPLICATIONS

The Clarage Multitherm unit shown above is a complete conditioning plant* . . . (1) it *cleans* the air, removing bacteria, pollen and dust . . . (2) it *cools and dehumidifies* in summer utilizing cold well water, brine or a direct expansion refrigerant . . . (3) it *heats and humidifies* in winter using steam or hot water . . . (4) it supplies at all times a circulation of conditioned air under positive fan pressure.

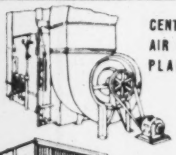
Multitherms are as easy and inexpensive to install as unit heaters — and just as satisfactory in operation. They may be suspended from the ceiling, mounted on platforms, or installed on the floor. Sizes range from 400 to 13,600 c.f.m. If the job is extra large, it can be handled with two or more units.

Look into Clarage Multitherms if you have any type of air conditioning problem. They are engineered to give precision results — compact to save space — of heavy duty construction for years of continuous trouble-free service. *And, as compared to central station conditioning, you can usually save considerable money.*

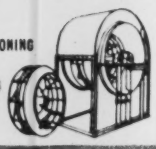
Write us, outlining your requirements — or ask for Bulletin 107 giving complete information.

SOME OF OUR OTHER PRODUCTS

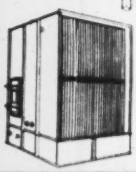
UNIT HEATERS



CENTRAL STATION AIR CONDITIONING PLANTS



AIR CONDITIONING AND VENTILATING FANS



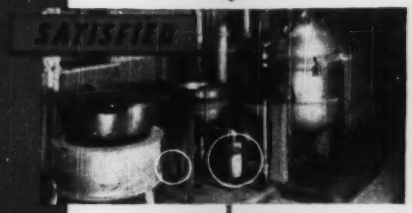
AIR WASHERS

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

"This Steam Trap is unconditionally guaranteed to satisfy you!"

YOU CAN'T LOSE



SAVED 3728 GALLONS OF FUEL OIL in one year after replacing old traps with Armstrongs on kettles, low pressure heating system and cream beaters.—*Mary Lincoln Candies, Buffalo, New York.*

30% LESS MAINTENANCE with Armstrong traps on heating and steam distribution system.—*John Deere Harvester Works, East Moline, Ill.*

COOKING KETTLE OUTPUT SPEEDED UP 30% by Armstrong trapping on each steam jacketed kettle.—*Bulman's Ltd., Vernon, B. C.*

EVERY Armstrong steam trap is guaranteed to be free from defective workmanship or material, to function perfectly, to fulfill all claims in every respect and to give complete satisfaction.

ONLY A GOOD STEAM TRAP COULD *POSSIBLY* BE BACKED BY SUCH A GUARANTEE! To save fuel, to reduce maintenance, to get more work out of existing equipment, to get complete steam trap satisfaction, ask your nearby Armstrong representative to discuss with you the traps you need now.

ARMSTRONG MACHINE WORKS
894 Maple St., Three Rivers, Mich.

SEND FOR YOUR COPY OF THE 36-PAGE ARMSTRONG STEAM TRAP BOOK explaining the design and workmanship that make the Armstrong guarantee possible. Complete data on the selection and installation of traps for all classes of equipment. Free on request.

ARMSTRONG STEAM TRAPS

How to be right in the center of things

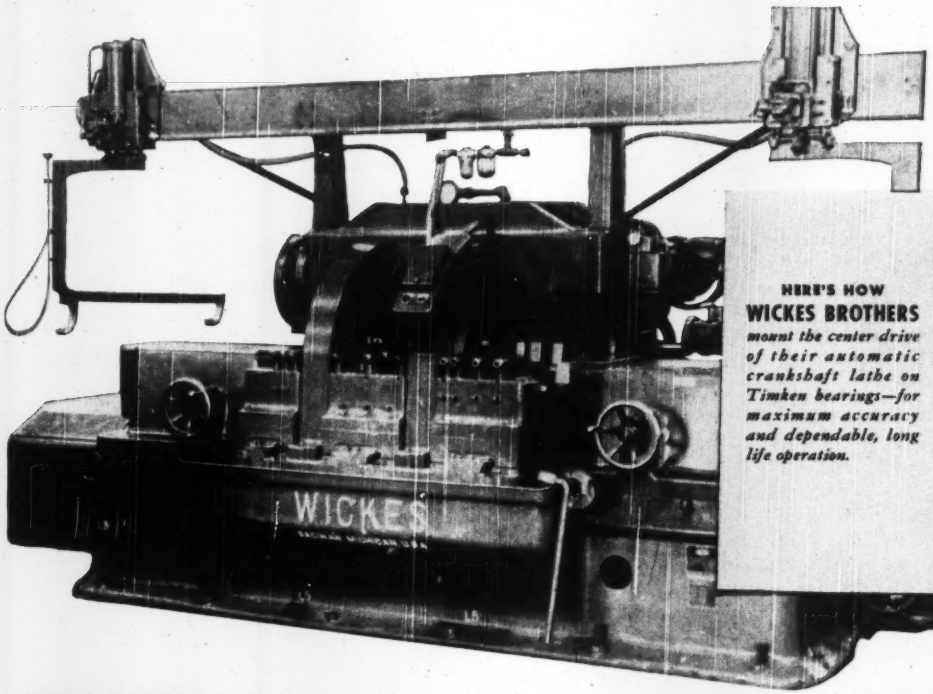
WITH a center drive crankshaft lathe like the one shown below, continued accuracy and high speed production depend largely on the big bearings in which the center chuck revolves. For maximum precision and dependable operation with minimum friction, Wickes Brothers mount the center drive on Timken® tapered roller bearings.

Due to the line contact between the rolls and races, Timken bearings have extra load-carrying capacity—give the center chuck maximum support. The work is held in proper position. The tapered construction of the bearings enables them to carry both radial and thrust loads—in any combination.

Timken bearings are precision products throughout. The rolls and races are made of Timken fine alloy steel for toughness, then case-hardened for exceptional resistance to wear. True rolling motion, and incredible smoothness of rolls and races results in virtually friction-free operation.

Over the years, the dependable performance and public acceptance of Timken bearings have made Timken-equipped products first choice throughout industry. Timken bearings help build greater preference for your product among customers. When you specify bearings, specify "Timken". And when buying new equipment, make sure it is Timken bearing equipped. Look for the trade-mark "Timken" on the bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



HERE'S HOW WICKES BROTHERS *mount the center drive of their automatic crankshaft lathe on Timken bearings—for maximum accuracy and dependable, long life operation.*

FINISHED TO CLOSER TOLERANCES

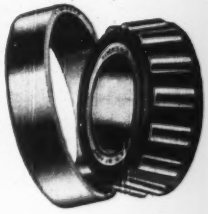
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at Timken.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⬯ AND THRUST ⬯ LOADS OR ANY COMBINATION ⬯